Journal

of the

Royal Army Medical Corps

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EDITED BY

COLONEL W. H. HORROCKS,

ROYAL ARMY MEDICAL CORPS

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MAJOR C. E. POLLOCK,

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VOL. XX.

January—June, 1913.

JOHN BALE, SONS & DANIELSSON, LTD.

OXFORD HOUSE,

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W.

No. 1. January, 1913. Vol. XX.

J. J. Fotheringham
Toronto

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Printed and Published by
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Price Two Shillings net.

VOLUME XX. JANUARY, 1913. No. 1.

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Original Communications.

ON "*STREPTOCOCCUS RHEUMATICUS*" AND RHEUMATIC FEVER.

BY MAJOR W. S. HARRISON.
Royal Army Medical Corps.

IN commencing a study of rheumatic fever, it is necessary in the first place to come to some decision as to what is to be included in the term. Speaking generally, it may be said that, clinically, rheumatic fever is a disease of indefinite duration characterized by fever, sweating, transient non-suppurating inflammation of joints, and by the very frequent occurrence of cardiac lesions. It is well-known, however, that all or most of this group of symptoms may be produced by gout, may occur as complications of gonorrhœa, or as part of a pneumococcal, staphylococcal, streptococcal or other septicæmia, or again as the result of serum disease. Cases of this kind are frequently reported in medical journals and there are probably few practitioners who have not come across them. As examples the series of five cases of pneumococcic septicæmia recorded by MacCordick[1] might be mentioned. In all of these there was non-suppurative arthritis, resembling that of rheumatic fever; endocarditis or pericarditis occurred in some of them; four of the patients had a previous history of "rheumatic fever" and one had had chorea. I have also reported a case of this kind,[2]

[1] *Lancet*, 1910, vol. ii, p. 1503.
[2] JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, 1911, vol. ii, p. 481.

the causal organism being apparently a *Staphylococcus aureus*. In many instances the presence of special features sooner or later gives a clue to the nature of such cases; if the inflammation fixes itself in a joint, produces permanent damage of joints, or goes on to suppuration, most observers would remove the case from the classification of acute rheumatism. Though even in these circumstances there is not absolute unanimity; Poynton[1] asserts that suppuration may occur in rheumatic fever, and that the transient character of the arthritis may be missing, so that we may even get osteo-arthritis as a part of acute rheumatism. Gonorrhœal arthritis has for its special characters the tendency to involve peri-articular tissues and tendon sheaths, and to become localized in one or two joints after a preliminary skirmish round the body; but quite a number of undoubted cases of gonorrhœal arthritis behave in every particular like rheumatic fever. Similarly it is by no means the rule for arthritis occurring in the course of one of the septicæmias to go on to suppuration. Where blood and joint cultures are undertaken the true nature of many of these cases, which would otherwise be classed as rheumatic fever, is disclosed; but there still remains a residuum in which neither clinical symptoms nor pathological findings provide a certain guide, and which one must, until the advent of further knowledge, class as rheumatic fever.

Those who believe that salicylates have a specific effect on rheumatic fever would take the action of these drugs as the final touchstone in cases of doubt; how then are cases which do not respond in the slightest to the drug to be classified? During the past three years we have had a number of cases at Millbank which presented the classical symptoms, fever, sweating, pain and swelling of large joints flitting about from one articulation to another, cardiac lesions being present in some of them, and yet large doses of salicylates had not the slightest effect on them; they usually ran a course of one to three weeks and then recovered spontaneously. Side by side with such cases were others with precisely similar symptoms which improved immediately with the same doses of salicylates. It is necessary to believe either that salicylates act erratically in acute rheumatism, or else that there is one disease called acute rheumatism in which they act, and another set of diseases bearing the same name in which they do not act. The distinction is sharp, for as a rule the drug either produces marked and definite relief in a short time, or it does no good at all. The position seems to be

[1] *Quart. Journ. of Med.*, 1909, vol. iii, No. 9, p. 15.

much the same as that of dysentery before it was recognized that there is one dysentery due to amœbiasis and others which are bacillary in origin. Those who chiefly came across amœbic dysentery had great faith in the value of ipecacuanha; a faith which, as events proved, turned out to be well grounded; whilst those whose practice brought them in contact chiefly with the bacillary dysenteries found that ipecacuanha was useless. Some observers consider that salicylates act only as analgesics and antipyretics; but these drugs do more than that—they interfere definitely, in those cases where they act, with the recurring attacks of arthritis; if they acted only as analgesics and antipyretics they should give relief in gonorrhœal arthritis, or in the arthritis of Malta fever, in which they are notoriously useless.

It seems highly probable then that there is one disease called rheumatic fever which is influenced by salicylates, which causes the greater number of cases of cardiac lesions in the young, and to which very likely the cardiac lesions described by Aschoff and Tawara,[1] Carey Coombs,[2] and others, are peculiar; alongside of this disease there are others indistinguishable from it clinically, except for the fact that they are not influenced by salicylates, but which have another causation. If this conception be a true one it is not difficult to understand how it is that the results of investigation as to causation have varied in different hands, and how one's mental picture of acute rheumatism must vary according to the nature of one's practice; in civil hospitals and especially in children's one is more likely to come across the more severe and prolonged cases, and possibly a higher proportion of those cases which are amenable to the action of salicylates, whilst doctors in general practice come across all varieties, from the most severe and persistent forms to those presenting the mildest transient arthritis.

The bearing of these remarks will become apparent when we come to consider the various bacteriological findings in the disease, and they are important to keep in mind in view of the fact that in papers by Poynton and Paine much importance is given to the fact that many of their cases were selected by clinicians of the highest eminence, and therefore, according to these authors, were undoubted cases of rheumatic fever. It would serve very little purpose to enter with great detail into the various speculations

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[1] *Brit. Med. Journ.*, 1906, vol. ii, p. 1103.

[2] *Quart. Journ. of Med.*, 1909, vol. iii, No. 9, p. 15.

which have been held as to the causation of rheumatic fever; one can only mention the lactic acid theory, the nervous hypothesis, and the neuro-toxic hypothesis, all of which depend but little on experimental or epidemiological data, and fail in many points to explain the lesions found, especially in the heart. MacLagan's[1] comparisons between malaria and rheumatic fever are chiefly of interest nowadays because of the way in which he draws attention to the action of salicylates in rheumatic fever. It is indeed a remarkable circumstance that if rheumatic fever is a bacterial disease it stands alone among bacterial diseases in the fact that it is influenced by a drug. On the other hand, there are many examples of drugs having a curative action on protozoal diseases; one need only instance malaria, syphilis and amœbic dysentery. Sahli,[2] in 1892, isolated a staphylococcus from the synovial membrane of a case of "rheumatic fever" fourteen hours after death; he expressed the opinion that acute rheumatism is an attenuated pyæmia caused by streptococci or staphylococci of slight virulence. This view, however, cannot be upheld in view of the fact that the cardiac lesions of streptococcic and staphylococcic pyæmia are, as pointed out by Carey Coombs,[3] essentially suppurative in nature, and differ entirely from the submiliary nodules with multinucleated cells which were described by Aschoff and Tawara,[4] and by Carey Coombs,[5] as occurring in the heart walls of cases of rheumatic pericarditis, and which are peculiar to that form of carditis. Carey Coombs himself failed to find organisms in the nodules, but he suggests that possibly this may have been due to the fact that he did not examine the material sufficiently soon after death. The distribution of the cardiac lesions in nodules and their localization chiefly along the cardiac vessels lends considerable support to the idea that they are more likely to be due to a particulate virus than to a soluble toxin, which might be expected to be more diffuse in its effects.

In 1891 Achalme[6] described a large sporing anaerobic bacillus which he found in the blood of rheumatic fever patients both before and after death. Several other observers found this same

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1 "Twentieth Century Practice of Medicine."

2 *Correspondenzbl. für Schweiz. Aerzte*, 1892, vol. xxii.

3 *Lancet*, June 8, 1912, p. 1529.

4 *Loc. cit.* 5 *Loc. cit.*

6 *Comptes rend. de la Soc. de Biol.*, 1891. *Annales de l'Inst. Pasteur*, 1897, vol. xi.

organism, though the majority failed to recover it from their cases. Thiroloix[1] by injecting a culture of this germ into rabbits produced symptoms resembling those of rheumatic fever, and some at any rate of the rabbits showed cardiac lesions; it has, however, been pointed out by Foulerton that it is by no means unusual to find valvular lesions in apparently normal rabbits, and Hewlett[2] identified Achalme's bacillus with *Bacillus enteritidis sporogenes* (Klein). Several observers have recovered streptococci or staphylocci from patients suffering from rheumatic fever, but they do not appear to have succeeded in reproducing arthritis with their cultures. Westphal, Wassermann and Malkoff,[3] however, recovered a streptococcus from the blood, heart valves and brain of a girl dead of endocarditis and nephritis associated with chorea; cultures of this organism injected into rabbits produced multiple arthritis after an incubation period of nine to ten days.. The coccus grew in chains on culture and required a highly alkaline medium for its growth. In 1900 Poynton and Paine[4] reported the finding in eight successive cases of rheumatic fever of diplococci in the blood during life, and post mortem in the cardiac valves, pericardial exudate and in a nodule. They also isolated streptococci from the throat of a patient suffering from rheumatic fever and from the urine of two cases of pericarditis. Inoculation of large doses of some of the strains produced multiple arthritis in rabbits, the affected animals showing clear to opaque fluid in the joints involved and diplococci or diplostreptococci were again isolated from the joints of the experimental animals. These authors have published from time to time records of further work in the same direction and in 1910[5] reported that altogether they had recovered streptococci from forty cases, and had succeeded in producing in rabbits not only multiple arthritis but all forms of carditis of the same order as is found in rheumatic fever, viz., scattered foci with degeneration of muscle around. They do not, however, give any description of the myocardial lesions present in their experimental animals, so that it is uncertain whether they showed the same structure as the submiliary nodules described by Aschoff and Tawara, or whether they were more of a simple inflammatory

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[1] *La Semaine Médicale*, 1896, pp. 376, 420.
[2] *Trans. Path. Soc. Lond.*, 1900.
[3] *Berl. klin. Woch.*, 1899, p. 638.
[4] *Lancet*, 1900, vol. ii, p. 861.
[5] *Ibid.*, 1910, vol. i, p. 1525.

character. Carey Coombs (*Brit. Med. Journ.*, 1912, vol. ii, p. 933) has recently made a preliminary announcement that he has succeeded in finding cardiac lesions essentially similar to those which are characteristic of rheumatic fever in rabbits inoculated with five different strains of streptococci isolated from cases of rheumatic fever. On the other hand, Leila Jackson (*Journ. of Infect. Dis.*, vol. ii, No. 2, p. 243), describing the heart lesions resulting from the intravenous inoculation of *Streptococcus viridans*, reports the finding in one rabbit (which had received four doses during two months) of nodules composed mainly of mononuclear elements, but including a number of large multinucleated cells. The streptococci which Poynton and Paine found appeared to grow best on acid media and preferred especially a medium containing broth and milk with a little lactic acid; beyond this and the fact that intravenous inoculations of their germs produced arthritis in rabbits, these authors give no details which would serve to distinguish the streptococci which they found from many others of the same group. Shaw[1] described the cultural characters of Wassermann's coccus; he found that it grew in chains of 8 to 10 elements, produced no general turbidity of broth, turned the hæmoglobin of blood agar to a brown or greenish-brown, and grew best on alkaline media; as a result of comparisons with Poynton and Paine's coccus he concluded that the latter was identical with Wassermann's strain, notwithstanding the fact that the one grew best on a highly alkaline medium and the other appeared to prefer acid media. Beattie[2] in 1904 gave a more detailed description of Poynton and Paine's coccus; he found that it grew in pairs or short chains, that it was smaller than most streptococci and the elements were often oval, broth was turned acid, and there was a slight turbidity which, however, soon cleared, leaving a flocculent deposit. On blood agar it produced the colour changes described by Shaw, and on this medium proved to be very long lived, up to eight and a half months; milk was acidulated in twenty-four hours and clotted after seventy-two hours. Beattie considered that the length of time it lived on suitable media and the marked acidity which it produced in broth served to distinguish it absolutely from other streptococci. In 1907 Beattie[3] reported further results of his examination of

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[1] *Journ. of Path. and Bact.*, vol. ix, p. 158.

[2] *Brit. Med. Journ.*, 1904, vol. ii, p. 1511.

[3] *Journ. of Exper. Med.*, 1907, vol. ix, p. 186.

cocci recovered from cases of rheumatic fever, the main results of which will be found in the table (Table I) appended; he again pointed out the great vitality of the germ, and gave as the only definite and very distinctive reaction the precipitation of bile salt in bile salt lactose broth, a reaction given by none of the other streptococci tested. Rabbits inoculated with streptococci from other sources gave doubtful agglutinins for the *S. rheumaticus*, whilst animals inoculated with the latter gave definite agglutinins for it as well as for streptococci isolated from a case of cellulitis. Beattie himself recovered the streptococcus in three cases from the synovial membrane, but not from the blood; in one case he isolated it from the synovial membrane, but not from the joint exudate. In 1911 this same author along with Yates[1] gave still further results of their studies of the *S. rheumaticus;* the cultural results are given in the appended table, and with regard to these they found that the reactions were fairly constant, the only variations from the streptococcus of rheumatic fever cases occurring with inulin. They succeeded in giving non-suppurative arthritis to rabbits by inoculation of cultures of streptococci from rheumatic throats and a similar result was obtained in one case by inoculation of a streptococcus from a case of peritonitis complicated by septicæmia. They state that "even with the organisms isolated from cases of rheumatism the inoculation results, though extremely interesting and suggestive, are not definite enough to justify any conclusions as to specificity." Buchanan[2] reported good results from the inoculation of a vaccine prepared from a streptococcus isolated from a case of endocarditis; the fermentation reactions of the organism which he describes are given in the appended Table I. He found in addition that the streptococcus gave acid in bile salt lactose broth with precipitate, formed formic acid in broth and gave positive results (arthritis) on inoculation into rabbits. With regard to the reactions shown in the table it will be noted that they vary considerably with strains of streptococci isolated from cases of rheumatic fever, even in the same worker's hands, and that streptococci from sources which are frankly not rheumatic fever may give the same reactions as those from cases diagnosed rheumatic fever. Two alternative explanations suggest themselves, either that more than one streptococcus may be concerned in the production of symptoms labelled rheumatic fever, or that the cultural characters

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[1] *Journ. of and Path. Bact.*, 1911, vol. xvi, p. 247.
[2] *Journ. of Vaccine Therapy.*, vol. i, No. 1, p. 1.

which are given in the table are not sufficiently stable or sufficiently distinctive to enable one to separate sharply those streptococci which have been isolated from cases of acute rheumatism from those isolated from other sources.

With a view to settling in my own mind the relation of the so-called *S. rheumaticus* to acute rheumatism, I obtained from Dr. Beattie a culture of the germ which he had recently isolated from a joint of a fatal case of rheumatic fever. I also obtained another strain from a different source; the history of the latter I do not know, but it seemed to be identical, so far as I could judge from cultural reactions and animal experiments, with the strain obtained from Dr. Beattie. The experiments which are given below were made chiefly with Dr. Beattie's culture. The organism was a small Gram-staining streptococcus, growing in short chains; its Gram-staining properties were distinct, though when recovered later on from joint effusion it showed a tendency to decolorize; this, however, is a usual finding with Gram-staining bacteria in tissues and exudates. The organism grew without difficulty on ordinary media, producing a very thin transparent growth on ordinary agar, which it seemed to prefer to blood agar; it did, however, grow on the latter to some extent and there was quite definite hæmolysis along the streak; there was diffuse growth in broth with no tendency to granulation of the growth or to deposit, milk and milk broth were clotted within twenty-four hours, and in media containing litmus the reagent was bleached in all but the upper inch or so of the tube. The remainder of the fermentation reactions are given in the table, from which it will be seen that the results differ from those given by Beattie; these, however, may be due to differences in the media used. One very remarkable feature of the culture was its extraordinary vitality, a point to which Beattie has drawn attention; in my hands it lived for over nine months in milk broth without subculture; I found, also, that it would live in ½ per cent. carbolic acid for more than two weeks and that it was not killed by heating to 60° C. for half an hour. This character of resistance seems to separate the organism sharply from most other streptococci and is obviously one to take advantage of in further searches for the germ. As regards its pathogenic effects on rabbits it is necessary to give a very big dose (six agar slopes of a twenty-four hour agar culture as a rule) if a certain result is to be obtained, though I have produced lameness with a dose of three agar slopes. When given in these doses, and intravenously, it produces lameness in from one to five days;

the lameness varies from day to day, sometimes the animal appears to recover completely for a while and then it breaks down again, practically always in the same limb, though now and again in the earlier stages of the illness lameness in another limb may be added. I have never observed the tendency for the lesions to flit about from joint to joint, which is so characteristic of acute rheumatism in man, nor have I been able to satisfy myself that chill was a factor in the causation of relapses. It is true that at times a rabbit is found more lame after a cold night, but equally often this happens when there has been no particular lowering of the temperature. The disease lasts a variable time; a rabbit may have a transient attack of lameness and recover completely in a few days, or it may go on for two months, relapsing and recovering. I have not kept them longer than this. The rabbits do not seem to suffer in their general health, they keep fat and their coats remain in good condition, Post mortem, alterations are found in one or more joints of the affected limb: sometimes in joints which have caused no symptoms for as long as ten days. There is a thick glairy fluid which may be transparent or markedly opalescent; at the early stages of the disease the fluid contains considerable numbers of endothelial cells and polymorphonuclear leucocytes, later on the latter are scanty and masses of coarse eosinophile granules, as well as fragments of chromatin, are found in the cytoplasm of the desquamated endothelial cells. The synovial membrane is swollen and jelly-like, and now and again patches of congestion, as described by Beattie, are seen on it. In one case, where the animal had been lame for eight weeks, there was thickening of the humerus and some erosion of the cartilage, a condition somewhat resembling that found in osteo-arthritis. Culture of the joint fluids and of the synovial membrane usually gave negative results in my hands unless the animal was killed and the cultures made within the first seven to ten days of the illness. I have not succeeded in recovering streptococci from patches of synovial membrane in cases where I failed to find them in the joint fluid. On three occasions I have seen definite vegetations on the heart valves, once on the tricuspid and twice on the mitral, but I have been unable to get any growth from any of these specimens; whilst sections of the heart muscle in the same cases showed no definite lesions. The serum of infected animals was found to contain thermostable opsonins for the streptococcus with which they were inoculated, but not for other streptococci. I showed

some time ago[1] that the thermostable opsonins which result from the injection of rabbits with streptococci are remarkably specific. The serum of infected rabbits also showed the presence of agglutinins when tested by growing the streptococcus in a broth containing 1-10 or 1-20 dilution of the serum; in this medium the organism, which ordinarily grows diffusely, grew as clumps at the bottom of the tube and the supernatant fluid was left almost clear.

In order to test the effect of giving salicylates to affected rabbits, four rabbits were each given a dose of five agar slopes of the streptococcus intravenously, lameness appeared as usual in all of them within the first week, and on the twelfth day after inoculation their condition was as follows:—

No. 1 was lame in both front legs. No. 2 was lame in both front legs. No. 3 was lame in the right hind leg. No. 4 was lame in the left front leg. From this date Nos. 1 and 2 were given daily doses of 3 gr. of sodium salicylate, subsequently increased to 5 gr., while Nos. 3 and 4 remained as controls; the subsequent progress of the animals is given in Table II. It will be seen from this that the salicylate had no effect on the symptoms, and as a matter of fact the animal which showed most symptoms throughout was one of those which was receiving salicylates; this animal recovered spontaneously a month later. With regard to these experiments on rabbits it will be noted that the dose of the germ required is very large and that it is not till we, as it were, flood the animal with streptococci that we produce joint lesions resembling those of rheumatic fever. It is, moreover, possible to produce arthritis in rabbits by germs from other sources than rheumatic fever, and the type of the arthritis depends greatly on the virulence of the germ. For example, four rabbits were inoculated intravenously with streptococci coming, in three cases, from erysipelas patients and in the fourth from a case of empyema. All four animals developed lameness in one or two limbs; in the case of those which had received the erysipelas cultures the arthritis was non-suppurative in character, while the rabbit which received the empyema streptococcus showed definite suppuration in both knees, the joints being found post-mortem to be filled with cheesy pus.

To pass on to rheumatic fever in man, if the causal organism is one which can be cultivated, as the *S. rheumaticus* can be, it would be expected that once in a way at any rate the streptococcus

[1] Journal of the Royal Army Medical Corps, 1909, vol. i, p. 282.

would be found in the blood-stream, since the lesions flit about from joint to joint, and it would seem likely that the germ, if there be one, would be carried by the blood-stream; moreover, in many cases of rheumatic fever there is affected tissue in the form of the heart valves actually lying in the blood-stream itself. I have made blood cultures in twenty-six cases of acute rheumatism, taking 5 c.c. of blood from a vein and inoculating it into milk broth, peptone broth, ascitic fluid and other media; the cultures were incubated at 37° C. at first aerobically, and later anaerobically; in every case I failed to get a growth of *S. rheumaticus* or any other germ; this result agrees with those obtained by McCrae,[1] Phillip,[2] and many others. I did, however, on one occasion recover a streptococcus from a case which was diagnosed clinically as malignant endocarditis. The patient had had an attack of tonsillitis eight days previously and returned to hospital suffering from gastric symptoms; two days later he had a rigor and from that time on for a month had high fever, urticarial rashes and severe pain over the præcordium and just above the middle of the clavicle there was also a double aortic murmur. A culture made with 5 c.c. of blood from a vein showed a growth of a short streptococcus resembling in many respects that of Beattie. As will be seen on reference to Table I, it showed much the same vitality, resisting heat to 60° C. for half an hour, but it only survived in ½ per cent carbolic acid for seven days and died out in a milk culture within a fortnight. I failed to produce joint lesions in rabbits with this germ and a rabbit whose serum showed thermostable opsonins for Beattie's streptococcus had none for the streptococcus of the endocarditis case. The patient recovered very rapidly and completely after the administration of four doses of an autogenous vaccine. In view of this it was thought desirable to try the effect of a vaccine of *S. rheumaticus* on rheumatic fever; six cases in all were treated in this way and none of them benefited in the least. This result contrasts with that of Buchanan[3] who reported good results in a number of cases of rheumatic fever and of chorea; the organism which he used seems to have resembled that of Beattie in many respects, but it did not clot milk, and there is no record as to whether it showed the curious capacity for surviving outside the human body which is so marked a feature of Beattie's strains. Microscopical examinations and

[1] *Journ. Amer. Med. Assoc.*, January, 1903.
[2] *Deut. Arch. f. klin. Med.*, 1903, vol. lxxvi.
[3] *Loc. cit.*

cultures of joint fluids from twenty-eight cases have been made; the fluid was removed as soon as possible, a portion of it was centrifuged for microscopic examination, and the remainder inoculated in various media; blood agar, blood broth, serum agar, milk broth, hydrocele water, glucose peptone and other media were tried, especial efforts being made to get a growth on the milk broth medium recommended by Poynton and Paine. In one case a smear of the centrifuged deposit showed two short chains of Gram-staining streptococci, but culture in this case gave no growth; in another case the patient had been in hospital for a few days suffering from "influenza" when he developed arthritis in one knee; an anaerobic culture in hydrocele water, peptone, dextrose, glycerine (3 per cent) resulted in a growth of a Gram-staining streptococcus; this proved to be a facultative anaerobe which gave a diffuse growth in broth, grew in a characteristic streptococcus fashion on agar and on Loeffler's serum, which it preferred; it produced acid in milk, but no clot. On my media it fermented glucose, saccharose, maltose, raffinose, salicin and inulin after forty-eight hours, but did not ferment lactose, thus contrasting with the reactions obtained on the same media with Beattie's coccus. It died out in milk within fourteen days and I lost the opportunity of trying the effect of heat and carbolic acid on it. Two rabbits were given intravenous doses of the germ, one receiving the growth on a Loeffler slope and the other that on five agar slopes; neither of the rabbits showed any symptoms as a result. The search for streptococci in the remaining twenty-four joint fluids was unsuccessful. The frequent association of sore throat with acute rheumatism naturally suggests that one might search in the pharynx and tonsils for the germ, and Poynton and Paine have reported the recovery in some cases of streptococci from the throats of rheumatic patients which caused arthritis when injected into animals. As, however, they did not attempt to differentiate the streptococci in any other way than by their effect on animals it is doubtful whether the germs which they recovered were the same as the ones which they obtained from joints, heart lesions, &c. The variety of streptococci found in throats, and especially in sore throats, is so great that the task would be endless if one tested every culture, so I adopted the plan of growing them in milk broth and only testing those which lived in this medium for four or five days. I found now and again a short streptococcus which clotted milk within twenty-four hours with bleaching of the litmus and which, on my media, fermented glucose only within the first twenty-four

hours, but none of them showed the same vitality as the *S. rheumaticus;* they all died out in milk broth within fourteen days, nor did I succeed in producing lameness in rabbits with any of them, except in the case of one culture. This was obtained from a man who had had several attacks of pain and swelling in his shoulders, elbows and wrists; he stated that each attack had been preceded by sore throat. A culture taken from the throat resulted in the isolation of a streptococcus which clotted milk within forty-eight hours, gave a diffuse growth in broth and an almost invisible growth on agar; it acidulated glucose peptone within twenty-four hours and after three days produced acid in lactose, sucrose, maltose and mannite; inulin, salicin and raffinose were unfortunately not tried. The culture in milk broth was found to be dead after fourteen days. A half-grown rabbit was given eleven agar slopes of this germ and five days later it developed lameness in its left hind leg, the lameness was not severe and the animal recovered completely in four weeks. The germ found in this case would seem to differ from the *S. rheumaticus* in the fact that it did not survive in milk broth and on my media it was much more active as a fermenter; it differed also in the appearance of the growth on agar, which was so scanty that at first sight there appeared to be no growth at all.

Examination of the opsonic index to *S. rheumaticus* of patients suffering from acute rheumatism regularly failed to reveal any alteration from the normal. As an example I might quote the following experiment in which the sera were taken and numbered by an independent observer. The opsonic index of the sera to *S. rheumaticus* was then taken, the control being the pooled sera of three normal persons; the results were as follows:—

	Opsonic index
(1) Pleural effusion (tubercular)	1·16
(2) Pleural effusion (cause?)	1·18
(3) Case of chorea with mitral disease	0·77
(4) Healthy man	0·96
(5) Case with four relapses of acute rheumatism in four months (mitral disease)	0·88
(6) Healthy man	1·08
(7) Recent rheumatism (mitral disease)..	0·91
(8) Healthy man	0·96

Lastly, an attempt was made to find out whether the sera of rheumatic fever patients contain thermostable opsonins or agglutinins for the *S. rheumaticus.* For this purpose the sera of men who had suffered from frequent attacks, or who had been ill for some time with the disease, were taken. The experiments showed that there were no thermostable opsonins or agglutinins for the *S. rheumaticus* in the sera of such cases, contrasting with the

TABLE I.

Observer	Origin of culture	Broth	Blood agar	Milk	Glucose	Lactose	Saccharose	Maltose	Mannite	Salicin	Inulin	Raffinose
Beattie (*Journ. Exper. Med.*, 1907, p. 186)	Case of rheumatic fever. Joint (?)	Slight turbidity, soon clears and culture deposits, marked acid formation	White colonies Hb becomes chocolate-coloured	Acid, 24 hours; clot, 48 hours	+	+ after 48 hours	+ after 72 hours	+	−	+	−	+ after 48 hours
Beattie and Yates (*Journ. Path. and Bact.*, 1911-12, vol. xvi, p. 247)	(p) Acute rheumatism (*p. m.*)	Do.	Do.	Acid, clot	+	+	+	+	+	+	−	−
	(o) Do.	Do.	Do.	,,	+	+	+	+	+	+	−	−
	(l) Do.	Do.	Do.	,,	+	+	−	+	+	+	±	−
	Case of acute miliary tuberculosis	?	?	,,	?	+	+	?	+	+	−	−
	Case of broncho-pneumonia	?	?	,,	?	+	+	?	+	−	−	−
	Ruptured aneurism ..	?	?	,,	?	+	+	?	−	+	+	−
	Cases of septicæmia 2	?	?	,,	?	+	+	?	+	+	−	−
	Cases of septicæmia 5	?	?	,,	?	+	+	?	−	+	−	−
	Cases of septicæmia 23	?	?	,,	?	+	+	?	−	+	−	+
Harrison	Strain supplied by Prof. Beattie	Diffuse growth	White colonies. Hæmolysis	Acid and clot, 24 hours	+	−	+ after 10 days	+ after 10 days	± after 10 days	−	−	−
	Blood malignant endocarditis	Do.	Do.	Do.	+	± 7 days	−	+	−	−	−	−
Buchanan (*Journ. of Vaccine Therapy*, vol. i, No. 1, p. 1)	Case of acute rheumatism, with endocarditis	Forms acid	?	Acid, no clot	+	+	+	+	+	+	−	?

condition of rabbits infected with *S. rheumaticus* where these substances are present.

TABLE II.—Action of Salicylates on Rabbits inoculated with *Streptococcus rheumaticus.*

Rabbit No.	Treatment	Condition on				
		12th day	19th day	21st day	28th day	37th day
1	Sod. sal. 3 gr. daily 12th to 19th day; 5 gr. daily 19th to 28th day	Lame both front legs	Better, but still lame both front legs	Much worse both front legs	No change	Lame
2	Ditto	Lame both front legs	No lameness	No lameness	No lameness	No lameness
3	Control	Lame right hind leg	Very lame right hind leg	Still lame right hind leg	Rather better but still lame	Recovered
4	Control	Lame left front leg	Slightly lame left front leg	No lameness	No lameness	No lameness

Summary.

(1) The *S. rheumaticus* has a special vitality outside the human body which serves to distinguish it from other streptococci.

(2) Inoculation of this streptococcus into rabbits in sufficiently large doses will produce arthritis and at times endocarditis.

(3) Inoculation of other streptococci will also produce arthritis at times, indistinguishable in character from that produced by the *S. rheumaticus.*

(4) Attempts to isolate the streptococcus from the blood failed in twenty-six cases.

(5) Streptococci were found in two joint fluids out of twenty-seven, but there was no evidence that they were identical with the *S. rheumaticus.*

(6) Attempts to isolate the *S. rheumaticus* from the throats of rheumatic fever patients failed.

(7) Treatment of six patients with a *S. rheumaticus* vaccine produced no results.

(8) Examination of the blood of rheumatic fever patients for antibodies to the *S. rheumaticus* produced negative results.

(9) Rabbits infected with *S. rheumaticus* are not benefited by the administration of sodium salicylate.

Conclusions.

There is no evidence that the *S. rheumaticus* is the cause of the usual kinds of rheumatic fever.

KNAPSACKS.

By Captain N. DUNBAR WALKER.
Royal Army Medical Corps.

"I left the lines and tented field,
Where lang I'd been a lodger;
My humble knapsack a' my wealth,
A poor but honest sodger."
("The Sodger's Return."—Burns.)

This piece of the infantryman's equipment has from time immemorial been suspended in some manner on the back.

The Roman soldier had a wicker basket suspended low down on the back by means of two leather thongs from the shoulders. This basket did not really constitute what we understand as a knapsack, being carried for use in constructing intrenched camps. It contained a small iron chain, leather straps for binding prisoners, and some kind of intrenching tool. To the outside of the basket were attached two strong pallisades. His food was carried in a leather bag which was slung from a long staff called the "ærumnule," which with its load, was carried on the shoulder, and would correspond more closely to the knapsack of modern times [1]. The practice of carrying such a leather or canvas bag on the musket, or on the rest, or on a stick, was still prevalent during the seventeeth century in this country. Cromwell's men had such bags.

Thus the first idea of a knapsack was a canvas or leather bag tied at the mouth or having a flapped cover, carried as already pointed out on a stick or more commonly slung on the back by a strap passing across the chest over one shoulder and under the other.

The word knapsack was often written "snap-sack" in early times, being evidently derived from the German "schnappsack," and probably the bag originally was fastened by a catch or snap.

Haversacks, also written aver-sacks, seem to have answered the same purpose in the cavalry, and it is probable the word is derived from the German word for oats "hafer," and meant a portable corn sack [2]. Marshal Saxe describes such a sack thus: "every man is to be furnished with a large sack 7 ft. in circumference, and 5 ft. in depth, with slings for the arms, these being filled with forage, and the men mounted again, are to be placed by their comrades *en croupe* but as close to their backs as possible." [3].

The Construction of the Knapsack.—At the present time most

of the foreign armies employ skin covered with hair in the manufacture of their knapsacks; the skin is usually stretched over a rectangular wooden frame as is done in Germany and Japan, but some patterns, *i.e.*, the Austrian, have no frame. The French, Italian, and Swedish knapsacks are made of waterproofed canvas, the former being black in colour and having a wooden frame, and the latter being grey, and without a frame. The Norwegians are peculiar in being the only Power to use the rucksack as a knapsack. Great Britain and the United States use a web equipment. The British pack is made of webbing, and the American is made by wrapping two flat-shaped pieces of canvas round the load. The Russians have a large haversack which acts as their knapsack, except their Guards, who carry an oblong black frameless canvas knapsack. On the outside of all knapsacks, straps are provided to secure the greatcoat and also the mess-tin in position, the latter usually being carried on the flap. In many countries, for instance, Sweden, Japan, France, Italy, and Norway, the intrenching tool is also fixed to the knapsack. The method of suspension on the back is almost always by braces attached to the upper edge of the sack, the front ends being secured to the belt, while the smaller straps (counter-straps) pass from the main brace in front under the arms to the back, to be secured to the base of the sack. These braces are always detachable except in the case of the Italian and Swedish Infantry and the Russian Guards; in these equipments the braces are sewn to the sack. The method of attachment varies; the German braces are secured by nuts; the French and Japanese by buckles; the Austrian by a metal rod. The counter-straps usually end in rings which engage hooks upon the sack, but some nations, as for instance, the Swedes, have only one hook and a buckle on the other side of the knapsack base. It is argued that when a knapsack is removed and placed on the ground the rings come away from the hooks, and that if a buckle is used on one side, when the knapsack has again to be put on, only one hook has to be connected up. A kit like the British web equipment, 1908, which can be removed by unbuckling the belt and laid on the ground, and assumed equally rapidly, is the ideal arrangement. The height of a knapsack (Table III) should be such that the counter-strap in passing backwards does not press on the axillary contents. Twenty years ago the French reduced the height of their knapsack by 2in., and there is no doubt that the trouble referred to has occurred, since French authorities have drawn attention to it. The Austrian knapsack is also only 10½ in. high, but is not open to these objec-

tions, as the counter-straps are attached to the sides of the cartridge-box. If a knapsack is not too wide it has the great advantage of allowing the free swing of the men's arms when marching. From this point of view the breadth at the bottom of the Norwegian rucksack is excessive. As regards the interior, a framework introduces extra weight and can well be dispensed with. In reality it is only retained for appearance sake. The practice of subdividing the interior also causes extra weight, but the Germans, who have carried this to an extreme, argue that it ensures a constant distribution of weight, that articles required are easily found, and that the contact of soiled linen with food is obviated. These are sound arguments which probably outweigh the disadvantage of extra weight, and bring out the disadvantages of the rucksack, where the contents are piled one on the top of the other. On the other hand, the Norwegians claim the advantage that, in an emergency, everything can be packed into the rucksack in a few seconds.

Recently, as the result of a competition in Germany, a knapsack similar to the men's has been adopted for officers, in material and weight. An experimental web equipment for officers has been tried at Aldershot.

The Carriage of the Knapsack on the Person.—The position of the knapsack on the back is of great importance. There are two positions in which it is carried, the dorsal and the lumbar. Most nations have adopted the latter, which is by far the best position, since it brings the load as near as possible to the centre of gravity of the body. The objections to the former method are that the sack in this position is placed further behind the centre of gravity than is necessary, that the respiration is impeded, since the pectoral and abdominal muscles are unnecessarily contracted to maintain the erect posture, and that the structures in the axilla are compressed, producing stiffness and numbness, which interferes with the shooting [28]. The difficulty in obtaining good results with the lumbar method are that there is no stable point on which the load can rest, as the loads naturally tend to slip off the sacrum.

The French still adhere to the dorsal position, although French military writers have drawn attention to its faults, and have suggested remedies such as constructing their back cartridge pouch in the form of a wooden box shaped to the body, on which the knapsack is to rest [4].

The shaping of the knapsack to the back, as is done in Germany, Austria, and Japan, does much to keep the knapsack weight as near the centre of gravity as possible. The Austrians have a

complicated arrangement for distributing the weight. The knapsack rests upon the back cartridge-box, which carries a web band stretched between two metal pieces. This band rests against the sacrum (fig. 16).

Any hard articles, however well designed, are liable to chafe the back, and even the new American pack, although soft, is not free from this objection. With a rucksack equipment the lumbar position is obtained, but the wooden *meis* of Norway, unless fitting very accurately, may cause chafing of the buttocks.

The British method, exemplified in the web equipment, in which the supporting straps take the weight to the belt, would appear to be the best. It is hard to believe that the Russian kit-bag slung on the left hip is popular with the soldier, yet men in Manchuria declared they preferred it to a knapsack.

Transport for Knapsacks.—The advantage of providing transport for knapsacks is well shown by the following quotation taken by Dr. Parkes [5] from the letter of a Prussian officer commenting on the difference in health of the Prussian soldiers who carried knapsacks in the Bohemian marches of 1866 and those who had not carried their packs; the latter "though they had not the comfort of their necessaries, were fresh and vigorous and in high spirits"; while the former were comparatively worn out and exhausted, although using the best military knapsack then known. The question of the practicability of transporting the knapsacks for the troops has received a good deal of attention. In the old days in India, the packs of the European soldiers were always carried for the men [26.]

In early days the soldier was allowed to employ someone to carry his knapsack, and this practice obtained both in England and on the Continent. These camp-followers were known as "knapsack boys," and were employed in the Civil War of the Seventeenth Century. In strong condemnation of this practice, Sir James Turner wrote in 1683, "I would have neither horse nor boy allowed them. It is too much that the custom of later times hath eased most of them of the burthen of defensive arms and therefore everyone both may and should carry his own knapsack and four or five days' provision of meat. . . . ." [6]. At the beginning of the Franco-German War, when it was desired to push forward the 8th and 10th Army Corps rapidly, the Germans arranged transport for the men's knapsacks, but the 10th Army Corps did not see their knapsacks again for a whole month, so that an intended relief actually resulted in increased hardship [7]. But it

might be imperative, especially at the beginning of the campaign, to relieve the men, particularly the reservists. In this case, transport must be provided for the knapsacks in spite of the risk of separating the men from their packs and also of the further evil of increasing the road space. We find in the German F.S. regulations (para. 346) that the carriage of the men's knapsacks "is only possible with small forces, or under exceptional circumstances" [8]. During the heat of the Manchurian summer (August, 1904), Kuropatkin issued orders that arrangements were to be made for carrying either the greatcoats or kit-bags. The Japanese employed coolie transport for forwarding knapsacks which had been left behind, and such a method would be practical with small bodies of troops such as the Abor Expedition, even on the march, but could never be entertained in a European war. It may be argued that the irreducible kit to be carried by the soldier has long been arrived at, and that changes in the equipment to be carried usually consist in transferring weight backwards and forwards between the man and the first line transport, but it must be borne in mind that owing to the increase in the number and quality of roads and in the number of railways, and owing to the advent of mechanical transport, the question of relieving the men of their knapsacks in a war in a civilized country ought to be more easily solved.

Transport of the Knapsack by the Soldier himself by some mechanical means.—Military wheel-barrows were tried by the French in Cochin China as far back as 1878. The wheel-barrow was formed by fixing two knapsacks to two light wheels and one man from every pair propelled the whole by using the two rifles as handles.

From time to time experiments have been made with what is known in France as the "roule-sac." [9] This is an attempt to provide the soldier with a portable hand vehicle, the parts of such a contrivance being distributed among so many men, each man carrying a share. When required, these different pieces are assembled to form a vehicle and the men's knapsacks are arranged on it, the men in turns drawing the vehicle.

The "Roule-sac" of Saint-Paul and De Roffignac consists of seven separate pieces, which it is claimed can be put together in 20 seconds, to form a tricycle. On this can be loaded eight knapsacks, and the whole can be drawn by one or two men. The total weight of the machine is 7 kil. 750 (17 lb.). The original model could only carry six knapsacks and the supporting framework was constructed with four sword bayonets. [10].

The Italians have also studied this method of transport and experiments have been made with the "roule-sac" individual (*zaino rotabile*) of Romano Castellani, of which there are three different types; one model was constructed to be trailed along behind the man and the other two could be wheeled along beside the soldier.

These contrivances weigh between 2½ and 3 lb. and are made of wood and metal, one type being constructed entirely of metal.

Dr. Castellani points out the following disadvantages of the collective "roule-sac":—

(1) The fact that the several parts to be carried are not of the same weight might cause friction amongst the men.

(2) If any one part of the machine is lost the contrivance is useless.

(3) If a part is lost great difficulty might be experienced in replacing it.

(4) A casualty from any cause amongst the seven men carrying the machine also renders it useless.

(5) The greater cost of such a machine [11].

Any contrivance increasing the length of a column could not be adopted on account of military considerations.

A column is lengthened 1 ft. per knapsack when Castellani's trailing pattern is used, and each company using one of the St. Paul and De Roffignac type requires another yard and a half of road space.

It is difficult to believe that such contrivances would be practicable on service, and if hand-wheeled transport is to be employed it would only be possible in those countries where the local hand-transport could be utilized, *e.g.*, the one-wheeled carts of China.

Contents of the Knapsack.—As a rule, spare linen and the various necessaries, such as soap, towel, toothbrush, &c., and the reserve ration, make up the main contents of a knapsack. Great Britain is the only country which carries the greatcoat inside the knapsack. On service, the occasional inspection of the knapsack contents will not be out of place, though the British soldier is not likely to load himself unnecessarily. The following account of the contents of the knapsack of a French soldier when leaving Moscow in 1812 is interesting. Serjeant Bourgogne relates: "I spent the time in making an examination of my knapsack, which seemed too heavy. I found several pounds of sugar, some rice, some biscuit, half a bottle of liqueur, a woman's Chinese silk dress, embroidered

in gold and silver, several gold and silver ornaments, amongst them a bit of the cross of Ivan the Great—at least, a piece of the outer covering of silver-gilt given me by a man in the company who had helped in taking it down. Besides these, I had my uniform, a woman's large riding-cloak (hazel colour, lined with green velvet; as I could not guess how it was worn, I imagined its late owner to be more than 6 ft. high), then two silver pictures in relief, a foot long and 8 in. high, one of them representing the Judgment of Paris on Mount Ida, the other showed Neptune on a chariot formed by a shell drawn by sea-horses, all in the finest workmanship. I had besides, several lockets, and a Russian prince's spitoon set with brilliants. These things were intended for presents, and had been found in cellars when the houses were burnt down" [12].

Whether ammunition and rations should be carried in the knapsack is a question depending upon the expediency of separating the soldier and his sack at any time, for where part of the ammunition is carried in the pack, as, for instance, in Germany and Norway, it can never have been intended that a man should ever be separated from this article. Most armies, however, have their equipment so designed as to allow of the knapsack being discarded should necessity arise, the Austrian and the British web equipment being two good examples. Lately it has been suggested in Germany that upon going into action the knapsack should be discarded and that the tent-piece should be formed into a bag to contain the greatcoat, the mess-tin, and the iron rations; the mouth of this package is to be closed by the greatcoat straps and fixed to the back by means of the haversack sling.

Separation of the Men from their Knapsacks.—It has always been a controversial point as to whether a man should ever be separated from his pack, and we think the general trend of opinion is against this practice in this country, except in very exceptional circumstances. It was Napoleon who instituted the modern system of personal equipment with a view to increased strategical mobility, and it is well known that he laid down five things from which a soldier should never be separated, namely: (1) Rifle; (2) cartridges; (3) knapsack; (4) rations for at least four days; (5) intrenching tool [27]. The modern idea is to reduce the load carried to the lowest possible weight, but at the same time to leave the individual an efficient fighting unit, although separated for a few days at least from all transport.

"An abandoned knapsack is a lost knapsack" is a very true remark, and there are many historical instances bearing this out,

but we cannot go further and say, "A soldier without a knapsack is a lost soldier" [13]. But war is subject to no rules and there are occasions when in order to carry more food it may be expedient to discard the knapsack. This course was adopted by Wellesley for the march along the coast towards Lisbon, in August, 1808. "The men had left their packs on board ship and carried only their greatcoats with a shirt and a pair of shoes rolled up in them, so that they might the more easily be loaded with four days' bread" [36]. With the advent of an "Iron Ration" in the British Army it may be necessary to adopt such a course if more than one of these rations has to be carried at any time. But the serious objection to such a course must always be carefully considered before it is undertaken.

There is no doubt that the men who disembarked in the Crimea leaving their knapsacks on board the transports suffered very considerably until these were recovered six weeks later, when it was found in many cases that the contents had been rifled. Another instance where men suffered from having their packs looted occurred to the 20th and 35th Regiments of German Infantry at Mars-la-Tour. In case of retreat the men may lose everything they possess, a misfortune which happened to the men of Frossard's Army Corps, who on August 6, 1870, went into action leaving behind them knapsacks, mess-tins, &c., and in consequence suffered much during the retreat on Metz [14].

The troops on Stonewall Jackson's most famous march to Manassas Junction (the second time) in August, 1862, carried no pack, and this is an example of exceptional circumstances demanding such an order [15]. The records of the last war show that the Japanese were on some occasions separated from their knapsacks for as long as a fortnight, and the Russians frequently discarded their haversacks and greatcoat rolls on going into action.

Description of the various Types of Knapsack.—Great Britain:— The knapsacks of Cromwell's pikemen and musketeers, already alluded to, cannot have been very elaborate articles, as they only cost the Government nine-pence apiece [16]. A century later the knapsack of a grenadier weighed, with its contents, 7 lb. 10 oz., and the knapsack itself cannot have weighed more than 2 lb. [18].

This article of the soldiers' equipment was included in necessaries, and had to be provided out of his pay and allowances once in six years [21]. It continued to be supplied in this manner certainly as late as 1844 [20]: "In the Peninsular war, the men carried bags (or pocks) like grain bags, weighing about two pounds,

and not framed knapsacks" [19]; and Oman describes the knapsack of Wellington's infantry as being very heavy and normally made of oilskin or glazed canvas [37]. James's definition of a knapsack of this period is: "A rough leather or canvas bag which is strapped to the soldiers' (infantry) back when he marches, and which contains his necessaries. White goatskins are sometimes used, but we do not conceive them to be equal to the painted

FIG. 1.—Frameless canvas knapsack on the hold-all principle, carried at Waterloo. It is shown slung too low down on the back.

canvas ones. Soldiers in the British service are put under stoppages for the payment of their knapsacks, which after six years become their property" [17]. There are two canvas knapsacks of the 10th Regiment of North British Militia (now the 3rd Battalion, the Royal Scots), in the Museum of the Royal United Service Institution. They measure about 18 in. square, with the outsides painted yellow, and are made on the hold-all principle. There are narrow leather slings attached to the centre of the back. These are the oldest type of which I have seen specimens, and date from

about 1795. In the Museum of the Royal Army Medical College there is a knapsack similar in material and construction to those just described. This was the knapsack of a light infantryman at Waterloo, and measures 17 in. by 10 in. when packed. It was slung high up on the back by broad buff leather braces (fig. 1).

Soon after this the framed knapsack was introduced, both in England and on the Continent. The knapsack and braces of a man in the Royal Staff Corps in 1832 weighed 4 lb. 0½ oz. [22], which is also the weight of the regulation pack given by Dr. Parkes in 1864. There is little doubt that this knapsack and the cross-belt were along with the methods of training then in vogue,

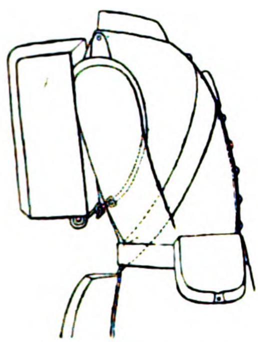


FIG. 2.—British regulation knapsack, 1860. (After Parkes.)

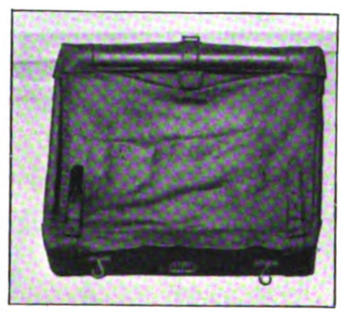


FIG. 3.—British regulation knapsack.

answerable for much heart trouble among young soldiers; it was in 1864 that Dr. Maclean, then Professor of Military Medicine at Netley, first drew public attention to this evil. This pack, measuring 14½ by 12 in., was made of canvas, painted black, shaped to fit over a removable wooden frame 3 in. wide (fig. 2). Two straps passed over the shoulders, and were fixed to hooks on the pack below. The whole weight (12 lb. loaded) of this pack was thrown on the clavicle, part of the first and second ribs and the pectoral muscles, and pressure was exerted on structures in the axilla, causing numbness, and often swelling, of the area. Unless the straps were very tight, the pack tended to drop back, falling to a still greater extent behind the line of the centre of gravity. An attempt to prevent this was made by fixing a stick to the inner edge at the top of the knapsack under which the braces passed (fig. 3). In the East the soldier never carried his pack. Up to

1842 he paid for his own transport on the march, but in the same year Lord Hardinge relieved him of that expense and provided transport for his *suleetah*.

It was not till Major-General Eyre's Committee convened in May, 1864, had issued its final (4th) Report in November, 1868 [23] that the "Valise Equipment" was evolved and adopted, marking a distinct advance in accoutrements from a physiological point of view. A great many different kinds of knapsacks were examined and experimented with by this committee, and a short account of some of them may not be out of place as illustrating the different attempts to solve a problem which is still with us.

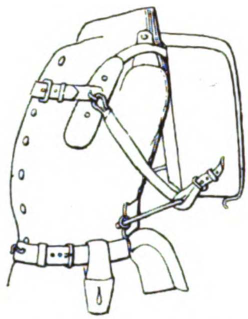


FIG. 4.—Colonel O'Halloran's knapsack. (After Parkes.)

As far back as 1857, a Mr. Berrington had shown his knapsack to the Royal Sanitary Commission of that date, and several witnesses spoke very highly of it. A form of this knapsack, as modified by Colonels Spiller and O'Halloran, consisted of a framed pack with leathern straps passing from the top of the pack over the shoulder and ending in two steel plates which rested against the chest. At the bottom of the pack were two short curved rods, between which stretched a broad band of webbing which lay in the small of the back (fig. 4).

In Mr. Fyfe's knapsack, straight iron rods projected from the top of the framed knapsack, just a sufficient distance to rest on the shoulders, at which point they were leather covered. From the extremities of the iron rods leather straps passed to the bottom of the knapsack (fig. 5, No. 2).

Colonel Carter's pack had projecting from the bottom two curved iron rods which passed forward under the arms, straps from the top of the pack were brought down and were fastened to the ends

of the rods. In this pack there was an attempt to afford ventilation to the back when the pack was in position, by means of a double back, the outer part of which was of wickerwork (fig. 5, No. 1, and fig. 6).

FIG. 5.—Knapsacks experimented with by General Eyre's Committee, 1863.
1. Colonel Carter's knapsack.
2. Mr. Fyfe's ,,
3. Dr. Parkes' ,,

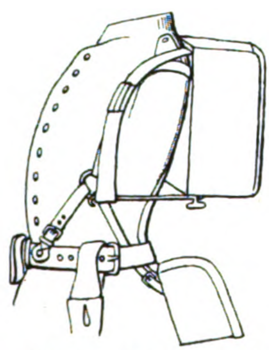


FIG. 6.—Colonel Carter's knapsack. (After Parkes.)

Sir Thomas Troubridge's equipment, consisting of yoke, valise, &c., was given a very extensive trial. His plan was to place the kit in a valise which lay on the loins and was supported by a yoke which rested on the top of the shoulders. The yoke was connected with the valise by two curved metal rods which passed in front of and beneath the arms without touching them (fig. 7). This yoke was really on the principle of the milkmaids' yoke and did not press on the chest in any way.

Mr. Truss's contrivance for slinging the pack was most compli-

cated. Behind and above the shoulders a horizontal iron rod was supported by two connecting rods. These rods passed through iron supporting plates fixed in the shoulders of the coat and were prolonged forwards and downwards to meet in the middle line of the body about the lower end of the sternum, where they screwed into a metal plate. From this point adjustable iron rods passed to the waist belt to which they were connected. From the horizontal rod the knapsack was slung on the back (fig. 8).

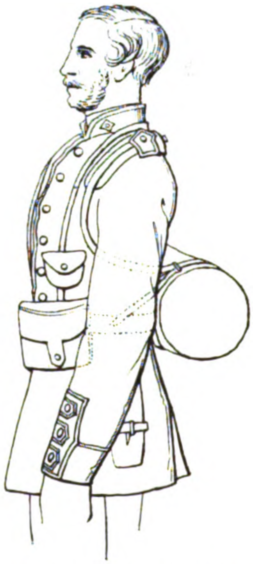


FIG. 7.—Sir Thomas Troubridge's original yoke and valise. (After Parkes.)

Finally there was the pack invented by Dr. Parkes, which consisted in an endeavour to use the hip bones as a point of support. Two iron rods fixed to the base of the framed knapsack were fastened to sockets in the waistbelt; two straps coming down in front over the shoulders were attached to these sockets (fig. 5, No. 3, and fig. 9).

It will be seen from the above descriptions how complicated were the methods proposed, and the committee very rightly considered that anything in the nature of iron rods as a part of an equipment was impracticable.

The yoke principle of Sir Thomas Troubridge was adopted, but leather was used throughout in its manufacture. Thus the "valise

FIG. 8.—Mr. Truss's contrivance for slinging the knapsack on the back.

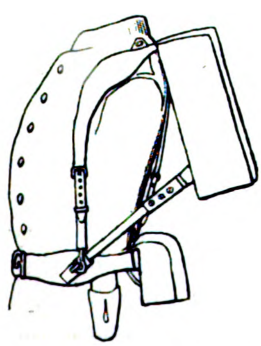


FIG. 9.—Dr. Parkes' knapsack. (After Parkes.)

equipment" came into being, a form which persisted with certain modifications until 1903, when it was replaced by the "bandolier equipment."

When introduced the valise equipment consisted of a waistbelt and frog, two pouches to contain twenty rounds each, a ball bag, a valise, brace-yoke and coat-straps. The valise was carried low down on the sacrum. The greatcoat, folded, was secured above by straps to the brace-yoke, and the canteen was secured to the outside of the greatcoat. A feature of this equipment was the ring in the mid-axillary line to which the brace ends and all the connecting straps were attached. The whole equipment could be put on and taken off like a greatcoat, and the men could "march at ease" with the waistbelt undone.

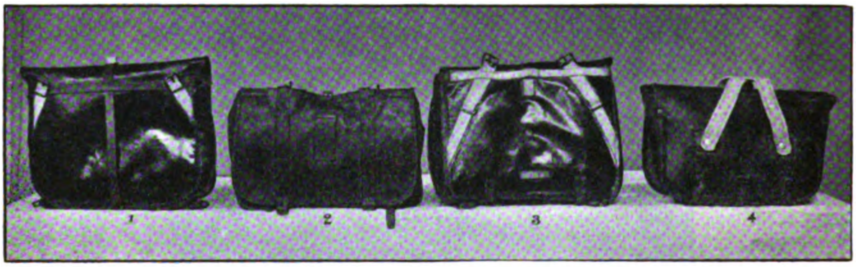


FIG. 10.—Posterior view of various types of valise.

1. Valise of original "valise equipment."
2. ,, Surgeon-Major Oliver's equipment.
3. ,, 1882 equipment.
4. ,, 1888 ,,

In 1878, experiments were made with the magazine accoutrements of Surgeon-Major Oliver. This equipment had separate yokes and braces for carrying the folded greatcoat and valise. Both the great-coat carrier and valise hooked on to their respective yokes. The valise was made of brown canvas with a leather back, and weighed just under 2 lb.

In the valise equipment, 1882 pattern, a somewhat larger valise was adopted, having the front and sides opening out, and the greatcoat was carried inside it. Both types of valise were made of japanned canvas. In 1888, another type of valise equipment was introduced, and the positions of the valise and greatcoat in the original equipment were interchanged. The valise was worn high up on the shoulders, and it was stated that the valise adapted itself to the width of the shoulders. The rolled greatcoat was attached to the belt. Some of these valises were made entirely

of leather. These alterations resulted in a lighter, cheaper, and less complicated equipment, and greater freedom of action was allowed by the omission of the straps passing under the arms (fig. 10).

The bandolier equipment, 1903, was introduced after the South African War, and in this no carrying receptacle was provided; web slings, of which a greatcoat carrier formed part, took the place of the valise. During and subsequent to 1903, extensive trials were made with various forms of web equipment, and the rucksack made its appearance in these trials, but the question of a rucksack equipment will be dealt with separately.

As a result of all these trials the present web equipment, 1908, was adopted, in which a return to the pack was made. It consists of a square canvas sack, which is supported in the lumbar position. The essential point to be remarked is that the weight of the pack is, in the first instance at any rate, carried by the narrow end-pieces attached to the cartridge carriers, and not by the suspension tabs at the top of the pack. The function of the latter is to keep the pack from falling away from the body. The supporting straps, which should be as taut as possible, are attached below to the narrow-end pieces coming out from the back lower corner of the cartridge carriers already referred to, and then pass diagonally across the front of the pack up to the small buckles on the suspension tabs. These supporting straps bind the pack tightly to the main body of the equipment and prevent it shifting. The pack is easily removed from the rest of the equipment without removing the latter or undoing any essential part of it.

The Egyptian and Soudanese infantry have no pack, being equipped with the bandolier equipment.

Native Army, India.—In the old days, knapsacks were worn by native troops in India; they were officially introduced about 1811, and were replaced by a pack in 1851 [24]. The Mackenzie equipment, introduced in 1887, had no pack, the greatcoat being attached to the braces, and at the present time the bandolier equipment which is in use is similar in this respect. The web equipment is to be introduced into India, but the pack will be replaced by the "strap-carrier."

Some units in India (1st and 5th Gúrkha Rifles and lately the whole of the Kashmir Imperial Service troops) have adopted a *ryper* or rucksack as their pack, and there is much to be said in favour of such a contrivance. Major-General C. H. Powell, C.B., has kindly presented to the Royal Army Medical College Museum

a set of his design of rucksack equipment, as now worn by his old regiment, the 1st Gúrkha Rifles. The rucksack is made of strong green canvas, procured in this country, and made up regimentally

FIG. 11.—Rifleman, 5th Gúrkha Rifles.

in India. The slings are made of 2-in. webbing, both attached to a cord ring at the apex of the sac; this ring is threaded through two eyelet holes in the sac. Brass rings sewn to the other ends

of the slings are secured to the bottom corners of the sac by short cords. It is by means of these cords that the adjustment of the length of the slings is obtained. The sack measures 19 by 17 in., and on the outside is a web cage, in which the aluminium water-bottle is secured. All the cord fittings are made by the men themselves and are easily repaired in the field. The mouth of the sac is closed by means of a running cord with a flap buttoning down over it. The chief advantages of this form of pack are simplicity, lightness, and cheapness. It also has an "expansive carrying power," as, for instance, a man going on picket can put extra food and ammunition in the sack, besides securing one rolled blanket round the sack and one folded between it and his body (fig. 11.) It can be put on and taken off in one second, as the slings are worn over the shoulder-straps. The criticism of this form of pack has always been that there is a tendency for the sack to swing from side to side on the back when men are "doubling" or descending a hill; this could be very easily obviated by connecting the bottom corner to the waist-belt by hooks. The better a rucksack is packed the better it rides, and the best method of packing is to place all heavy articles at the bottom and to make the whole pack as flat as possible.

For hill work this is the natural method of carrying a load, and Tyrolean and Alpine guides always employ it. It is, then, certainly advantageous for regiments who may have to operate on the frontiers of India to be equipped with such a pack.

TABLE I.—Weights of Different Pattern Valises without Slings.

			lb.	oz.	
1st valise equipment,	1868	.. ..	2	3¾	japanned canvas.
Oliver's valise,	1878	.. ..	1	15	canvas.
Valise equipment,	1882 pattern	..	5	13½	japanned canvas.
,, ,,	1888 ,,	..	1	13½	leather.

TABLE II.—Weights of Indian Rucksacks and Slings.

		lb.	oz.	
1st Gúrkha Rifles..	.. .. ..	1	3¼	cord fittings.
5th ,, ,,	.. ..	1	5¾	leather fittings.
Kashmir Imperial Service troops	..	1	14½	,, ,,

Germany.—The Prussian pack of 1860 was cut to the back so as to fit into the hollow below the scapulæ [25]. It was made of cow-hide skin covered with hair, stretched over a wooden frame, and measured 14 by 12 in. and was 5 in. deep at the top increasing to 6 in. at the bottom, the front surface forming a curve (fig. 13, No. 1, and fig. 12). From the top of the pack two broad straps passed over the shoulders to be attached in front to the waist-belt; from

3

these straps at a level a little below the axilla, narrower straps passed back to be hooked to the bottom of the pack. This was the first attempt at counterbalancing the pack by means of the weight of the ammunition on the belt.

The knapsack was divided by a wooden partition into two compartments, the upper one being only 2 in. high and containing three tin cases for ammunition. The lower compartment contained kit, consisting of one pair of boots, one pair of linen trousers, one linen shirt, one pair of socks, and the necessaries. This knapsack was easily taken off and put on without assistance and the straps did not in any way press on the vessels or nerves of the axilla, avoiding the very serious defect of the British regulation pack of that time.

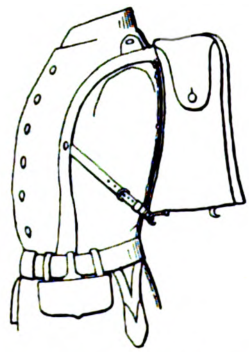


Fig. 12.—Prussian knapsack, 1860. (After Parkes.)

Later, a smaller and lighter knapsack was introduced which was made of the same materials but with no wooden frame; it measured 13 by 11 in. and only 4 in. deep. The interior was not divided in any way, but a pocket for a tin case of ammunition was provided on each side (fig. 13, No. 2). The knapsack of 1887 measured $13\frac{1}{2}$ by $12\frac{1}{2}$ in. and was $1\frac{1}{2}$ by 3 in. deep. Cow-hide was still employed and a return was made to the wooden frame (fig. 13, No. 3). The interior was not divided in any way, but a large canvas bag (*tornister Beutel*) was suspended between the outside flap and the flaps closing the cavity proper. The brace slings were attached to the upper edge by means of a metal rod which passed through loops on the braces and knapsack edge. There were three such loops on the braces at different levels, allowing the position of the knapsack to be adjusted on the back.

The bag already referred to as hanging in the interior was

attached to the knapsack in the same way, and it was intended that this canvas bag should, on occasions, replace the knapsack on the braces, so as to lighten the load. The lower ends of the braces joined at the centre of the back, and from here a single strap depended which carried a hook to engage the belt, thus taking the

FIG. 13.—Various knapsacks.

1. Prussia, 1860.
2. ,, later pattern.
3. Germany, 1887.
4. ,, present day.
5. France, old pattern.
6. France, present day.
7. Italy, old pattern.
8. Japan, present day.
9. Austria, ,,
10. Sweden, ,,

weight of the large rear cartridge box which was attached to the belt and also to the bottom of the knapsack. This arrangement still obtains in the present Austrian equipment. The 1895 knapsack, which is the present pattern, has several further details worthy of note (fig. 13, No. 4).

The hide is shaped over a wooden frame 2 in. wide at the corners and cut away at the sides to 1½ in. and is made in three

sizes. The whole is shaped to the back. The interior is lined with canvas and there are two separate canvas bags which hang in the interior and a large pocket in the flap. The upper and smaller bag *Zeltzubehörbeutel*) (fig. 14, No. 3), is for the shelter tent accessories, the larger (*Lebensmittelbeutel*) (fig. 14, No. 4), is for part of the

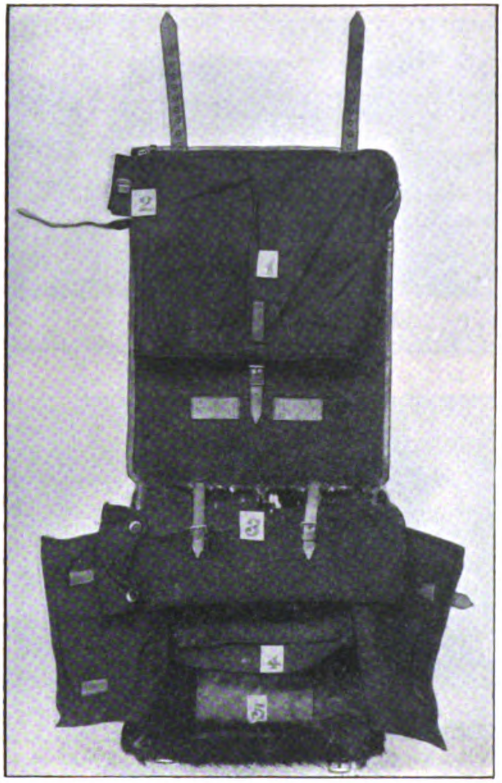


FIG. 14.—Interior of present German knapsack.

1. Linen bag (*Wäschebeutel*).
2. Ammunition pocket (*Patronhälter*).
3. Tent accessories bag (*Zeltzubehörbeutel*).
4. Ration bag (*Lebensmittelbeutel*).
5. Pad against which tin of meat rests.

iron ration. The pocket in the flap (*Wäschebeutel*) (fig. 14, No. 1) is for the linen. At each corner of the flap there is a small pocket for ammunition (*Patronbehälter*) (fig. 14, No. 2). At the bottom of the main area of the knapsack there is a leather-lined pad or cushion (fig. 14, No. 5), against which the tin of meat belonging to the iron ration rests.

The braces are 2 in. wide and are attached to the upper edge of the knapsack by means of ingenious nuts which engage holes in the braces. There are three such holes in each brace to allow for adjustments. The front ends of the braces have hooks which engage D's on the cartridge pouches. At the level of the armpit, fixed to a stud in the main brace, is a narrower strap carrying a ring which passes backwards to engage a hook on the bottom of the knapsack.

The greatcoat rolled in the shelter tent piece is strapped, horse-shoe fashion, round the outside, and the mess-tin is strapped to the

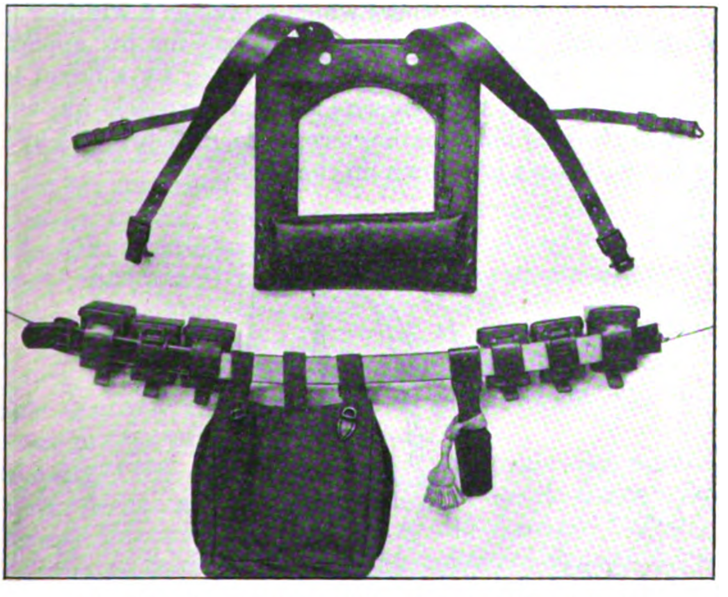


FIG. 15.—Carrying frame of German colonial Gepäcksack.

flap. The flap is longer than is necessary to cover in the main area of the knapsack, and thus allows articles to be placed underneath it.

The Colonial-pattern knapsack (*Gepäcksack*) is made of dark green waterproofed canvas, and is attached to a rectangular leather covered aluminium frame, the sides of which are shaped to fit the back. The frame is 13 by 15 in., the sides being 2½ in. wide (fig. 15). There is a pad movable up and down for a distance of 6 in. along the bottom piece of the frame. The braces and their attachment are similar to those of the 1895 pattern knapsack, except that there are two sets of hooks at the bottom at different levels.

The *Gepäcksack* is divided longitudinally into two compartments, the whole sack measuring 6½ by 13 by 7 in. Below the sack is the bag for the shelter-tent accessories, and over the lower half of the frame are strapped the greatcoat and the shelter tent-piece. At each corner of the sack is a cartridge pouch of soft leather, and to the outside flap the mess-tin is strapped.

France.—Until 1740 the French soldier carried a canvas wallet (*besac*) slung over his shoulder. Each soldier made his own wallet according to his taste. In 1767 the wallet was abolished altogether and the knapsack which had been introduced in 1747 was used by all. These first knapsacks were made of a piece of canvas 4 ft. by 2 ft. 6 in., with rounded corners which served as a wrapper for the man's effects and contained a small skin bag for his apparel. It was slung over the shoulder like a game bag by a broad leather strap. Later, in 1776, the modern idea of a knapsack was adopted, namely, a duck-lined hairy leather receptacle, measuring 14 by 15 in., carried by two braces low down on the back.

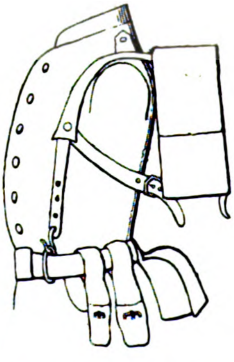


FIG. 16.—French knapsack, 1861. (After Parkes.)

In those days the knapsacks were always discarded before an engagement, and the men only carried them on the march in exceptional circumstances, as each soldier was allowed a soldier servant (*goujats*) to carry his kit. The great number of followers thus entailed became a nuisance and the allowance was reduced in 1785 to one servant for three men. Even if the knapsack was carried on a practice march it was usually empty, and when units changed station the men were allowed to arrange and pay for transport to carry the contents of their knapsacks.

In 1812 the wooden frame for the interior was adopted, but for

campaigning this type was very unpopular with the men and was not generally adopted until a date somewhat later than Waterloo.

The pack of the Chasseurs de la Garde in 1861 was similar in many respects to the Prussian knapsack of the same date. The pack was not however shaped to the back, but the front end of the brace hooked on to the belt and a strap from the main brace passed backwards and was buckled to the bottom of the knapsack (fig. 16.) After the Franco-German war, blackened canvas replaced the hairy hide as the material for their manufacture.

The old canvas knapsack (fig. 13, No. 5) differed from the present model (1893) in having a box which ran along the top of the frame, containing a tin tray with seven divisions for cartridges. The abolition of this tray reduced the height of the knapsack slightly. The displaced ammunition was transferred to a pouch on the belt at the back. The wooden frame of the present pattern (fig. 13, No. 6) is 4¼ in. wide and three-ply. There are no divisions in the interior, but the flap has a pocket.

There are the usual straps for securing articles in position, one strap known as the "load strap" securing the mess-tin (*marmite individuelle*) in position on the outside of the flap. The braces are buckled to the top and passing under the arms are attached in the same manner to the bottom of the knapsack. The French, it should be noticed, are peculiar in having two sets of braces for their equipment, the belt being supported by its own set. At the "halt" the men are only allowed to remove the knapsack, the braces of which are always worn over the other set.

Recently (1908) experiments have been made with a soft brown rucksack. It lies when carried somewhat low on the back and has two straps through which the arms are passed. The saving in weight over the framed knapsack is considerable, namely, 1,100 grm. (2.4 lb.) [33].

At the present time an experimental web rucksack equipment is being tested.

Austria.—A small frameless knapsack of cowhide, lined with canvas, is carried by the Austrians. Its shape in section (fig. 13, No. 9) is different from most knapsacks. The braces are attached to the upper edge by an iron rod, a method of attachment found in the old German knapsack already described. The front ends carry hooks for attachment to D's on the cartridge pouches which are carried on the belt. The counter-straps attached to studs on the main brace pass under the arms and rings at their extremities engage hooks on the side of the cartridge-box. The braces meet

behind (see fig. 17) and are connected by a metal stud; from this stud depends a strap which carries a hook to grasp the belt from below.

The mess utensil is strapped on the flap, and the greatcoat rolled in the tent piece is carried horse-shoe fashion round the whole. The flap, as in the German knapsack, overlaps the lower edge of the body of the knapsack, enabling articles to be placed underneath it.

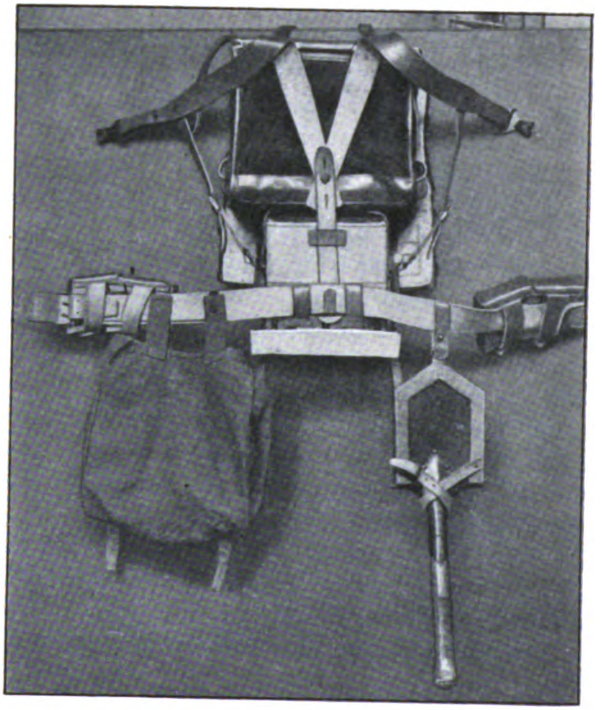


FIG. 17.—Posterior view of Austrian accoutrements.

Russia.—At the present time only the Russian Guards have a knapsack, although in the Crimea and in the Russo-Turkish war of 1877 all the infantry had knapsacks. The knapsack of 1877 was made of black leather with a wooden frame, and was closed by a hairy flap. The braces were similar to those of the British Army knapsack prior to 1873 [29]. There is an old leather bag on the rucksack principle in the College Museum, which must date before this period (fig. 18). The Guards' knapsack of to-day is

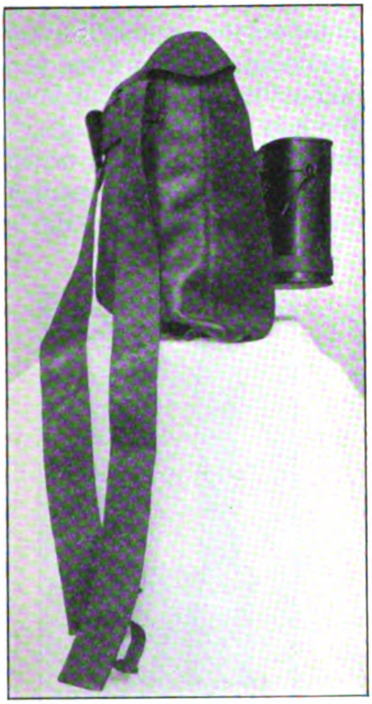


FIG. 18.—Old leather rucksack (Russian).

FIG. 19.—Russian Guards' knapsack.

frameless, oblong in shape, and made of black canvas, edged with leather. It is suspended on the back by leather braces sewn to the upper edge of the sac and buttoning on to studs on the broad canvas belt in the mid-axillary line. The lower edge of the knapsack is attached to the belt (fig. 19).

The large haversack of the infantry, which corresponds to the knapsack of other armies, is made of greenish waterproof canvas. There are no partitions in the interior but the bottom is expandable.

FIG. 20A.—Russian haversack (slings connected up).

The usual method of carriage is by means of a broad sling $2\frac{3}{4}$ in. wide, over the left shoulder. There are, however, actually two slings, each 3 ft. 4 in. long, and upon them 11 in. from their attachment to the haversack are sewn tongueless buckles to engage the opposing free ends. As a rule only one buckle is secured to form the single sling, but in case of necessity the haversack may be worn like a knapsack by buckling up both slings (see fig. 20, A and B).

Italy.—The old knapsack (fig. 13, No. 7) had a wooden frame with a partition at the top for holding cartridges. Access to this was obtained on the right-hand side of the knapsack, and the mouth was closed by a leather flap carrying a plug. This flap

covered in the whole top right-hand corner of the knapsack and buttoned on to a stud. This compartment was similar to that found in the old French and Prussian knapsacks.

The braces, 1·3 in. broad, were sewn to the upper face of the inner covering of the knapsack, and then passed round the cartridge box, and out through the back of the knapsack about 3 in. from the upper edge through openings strengthened by a solid piece of leather sewn to the back of the knapsack.

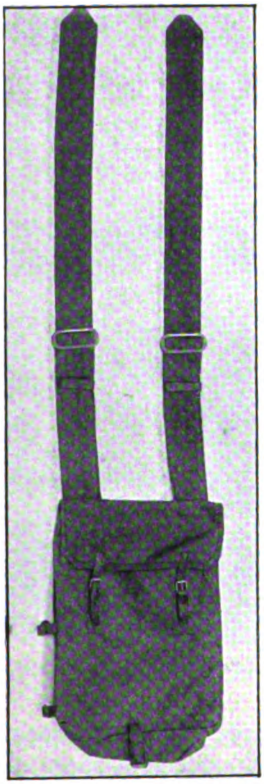


FIG. 20B.—Russian haversack (slings free).

The front end of the braces terminated in rings, the brace passing back to engage hooks on the lower edge of the knapsack. The two edges of that part of the braces which was situated under the arm were sewn together so as to form rounded thongs. To the leather reinforcement already described were also fixed narrow

straps carrying hooks, which passed forward over the shoulders to engage rings on the cartridge boxes.

A grey frameless canvas knapsack has lately replaced the old hide-covered frame. It is rectangular in shape and measures 12 in. square and 5 in. deep. There is a small pliable metal frame sewn into the upper inner edge of the sack to which the knapsack slings are sewn, otherwise there is no stiffening. The interior is divided into two compartments longitudinally, each closing by its own flap, a large outer flap covering in the whole.

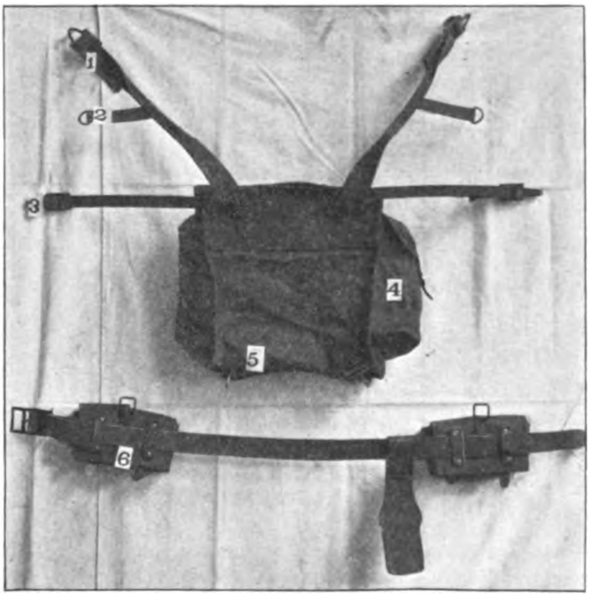


FIG. 21.—Posterior view, Italian accoutrements.

This outer flap carries straps for securing the greatcoat and shelter tent portion. At each side there are long pockets (fig. 21, No. 4) into which spare shoes are placed, and on the left side are straps for securing the entrenching tool in an upright position. To the outer surface of the knapsack the mess-tin is attached.

The slinging of the knapsack on the back is peculiar. The slings already referred to are only $1\frac{1}{2}$ in. wide (fig. 21, No. 1), and where they pass backwards under the arms the edges are sewn together in the same manner as the leather slings of the old knapsack. They end in D's which engage in hooks on the under-

surface (fig. 21, No. 5). Attached to the contracted part of these slings are narrow (1 in. wide) canvas straps, 4 in. long, with D's sewn on their ends (fig. 21, No. 2). Hooked to these the large haversack hangs suspended over the buttocks. The knapsack is further supported by a long narrow leather strap (fig. 21, No. 3) which passes round the neck through two rings sewn to the back

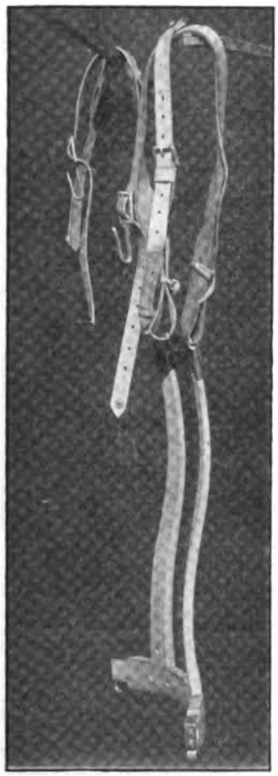


FIG. 22.—Norwegian meis (side view).

of the knapsack in the same place as the canvas slings. The free ends of this strap carry hooks which engage the D's on the cartridge carriers (fig. 21, No. 6).

Norway.—This is the only European country which has adopted the rucksack in place of the knapsack.

The sac is made of strong greenish-grey waterproof canvas, the mouth lacing up and being closed by a flap. This sac is attached to a wooden frame (*meis*). The *meis* consists of two vertical

pieces of wood 3 in. apart at the top, where they are joined together by a brass crosspiece. At the bottom these vertical pieces are 4 in. apart, and are riveted to a horizontal piece of wood. The vertical pieces are further secured to the horizontal piece by T-shaped brass pieces. The wooden pieces are $1\frac{1}{2}$ in. wide. The whole of this wooden frame is shaped to the back and is made in different sizes (fig. 22). Recently experiments have been made with a "meis" of light tubular steel.

The sac is attached to the top of the *meis* by a strap (fig. 23, No. 6), which is sewn down the centre of the back of the sack. The upper free end of this strap is passed through a slit in the brass

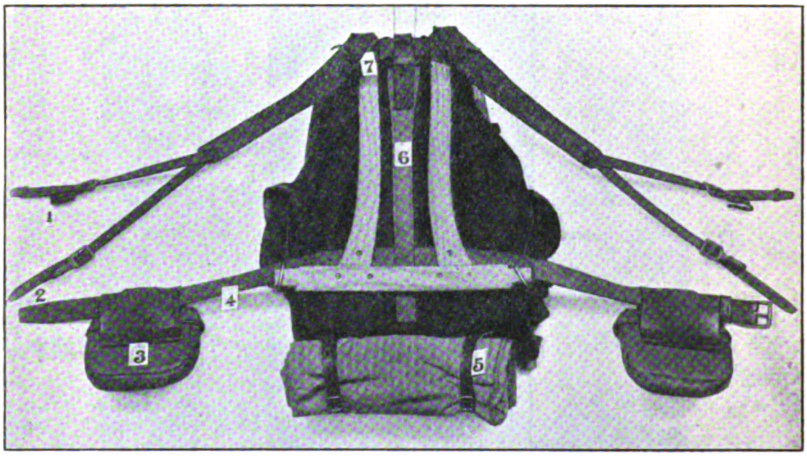


FIG. 23.—Posterior view, Norwegian accoutrements.

crosspiece, then bent back and buttoned on itself. There are metal rings sewn to leather bands on the bottom of the sack, which fit over the extremities of the horizontal crosspiece of the *meis* and are secured there by clips.

The braces for supporting the whole rucksack are attached above to D's on the upper ends (fig. 23, No. 7) of the vertical pieces, the free ends are bent back on themselves and secured by leather thongs knotted in a special manner. The main brace ends at the level of the axilla, and from studs sewn upon each of its ends two pairs of counter-straps depend. The front one (fig. 23, No. 1), carrying a broad hook, engages the belt from below, the other (fig. 23, No. 2) passes backwards, carrying a smaller hook to engage the rings already secured to the frame. All the leather used is of very good quality,

and has a peculiar light-blue colour. There are leather loops on the outside of the sac for securing the mess-tin, tent-pole piece, and entrenching tool. The tent-piece (fig. 23, No. 5) is attached to the bottom of the sac by two straps.

FIG. 24.—Swedish lyftreist.

Sweden.—Formerly the Swedes had the usual cowhide knapsack with wooden frame. The present knapsack (fig. 13, No. 10) has no wooden frame, but the canvas of which it is made is

strengthened, enabling the whole to be kept in shape by means of pieces of strong buckram at the top and bottom connected by pairs of leather-covered cane rods down each side. The back of the knapsack is of solid leather, and the remaining grey canvas parts are bound with leather. The slings are sewn to the top diagonally, and the counter-strap on the left-hand side buckles to the bottom of the sack; the right-hand counter-strap ends in a ring engaging a hook. The interior is not divided, but there are canvas flaps for securing the contents in varying positions.

The front ends of the braces end in hooks which engage D's on the belt.

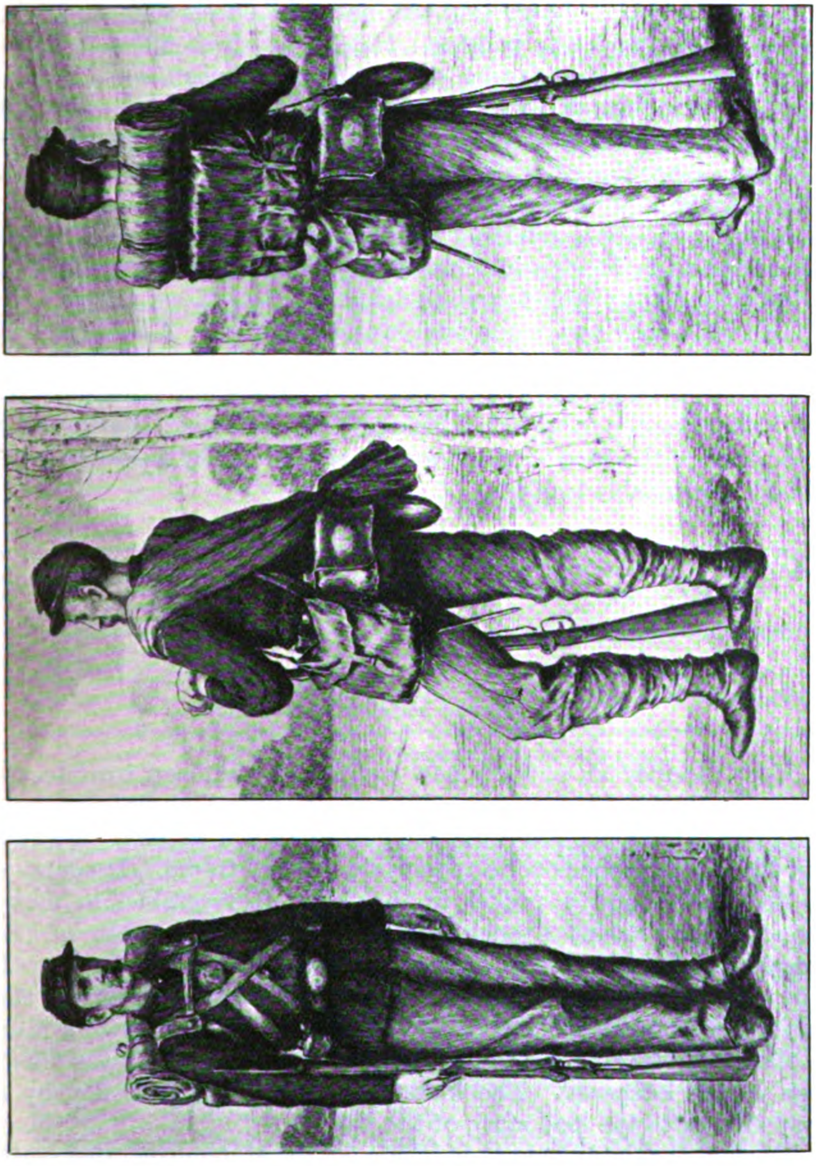
The special feature of the Swedish knapsack is the strap (*lyft-reist*) sewn to the centre of the top edge of the knapsack. This strap can be passed forward over either shoulder, and allows the soldier by pulling on it to raise the knapsack and relieve his back of part of the weight. Such a contrivance is a very valuable addition to a pack (fig. 24).

U.S.A.—At the beginning of the Civil War the knapsack in use was a heavy article, very objectionable by reason of its method of suspension by straps crossing the chest (see fig. 25, A and C), and "it was found to gall the back and shoulders and weary a man before half the march was accomplished" [30]. At the opening of the campaign these knapsacks were abandoned by the men, sometimes by the roadside. The men took "from their knapsacks a few things which they rolled in their blankets, the ends of which they tied together and slung over their shoulders, abandoning all other articles of clothing."

It was in this fashion that the "blanket roll" (fig. 25, B) came into existence. In the war in New Zealand, British troops adopted a similar procedure, blanket, greatcoat and waterproof sheet being formed into a "swag" [35].

In 1874 a board of infantry officers recommended the adoption of a *clothing bag*, which, with the haversack, was to be slung from a kind of yoke, consisting of a backpad with shoulder braces. "The braces adjusted themselves to fit any size or form of shoulders, and enabled a load to be carried without compressing the waist or chest, bearing down the hips or dragging the shoulders backwards." [31]. This was known as the "Palmer Brace System"; it was approved and the new equipment issued. But this was not a success, and was certainly never used on service.

In 1882 this *clothing bag* (also known as the *blanket bag*) was modified into a knapsack, carried high on the back by straps, which



A B C

Fig. 25.--Federal infantryman. Civil War.

(From a print in the "Medical and Surgical History of the War of the Rebellion," part iii, vol. i, "Medical History," 1888).

pass from its upper margin over the shoulder and under the armpit to its lower corners, in fact a return to the knapsack of the period of the Civil War. Even this was not used on service as it was unsatisfactory, and the unofficial *blanket roll* was allowed to be worn, and was in use during the Spanish-American war.

For a number of years the Merriam pack was allowed for regimental use, but not recognized officially [32]. In many ways this resembled the pack invented by the late Dr. Parkes already alluded to, part of the weight being transmitted to the hips.

Munson, in 1901, referring to the *blanket bag*, remarks, "It is safe to say that the present *blanket bag* is the most vicious article of the equipment of the American soldier."

In 1907 a new web equipment was introduced. A large canvas haversack depended from the belt, and was the only carrying receptacle provided, taking the place of the knapsack. The blanket and shelter-tent portion were carried in a roll over the shoulder *en bandolier*, the idea of the *blanket roll* still being retained with all its objectionable features.

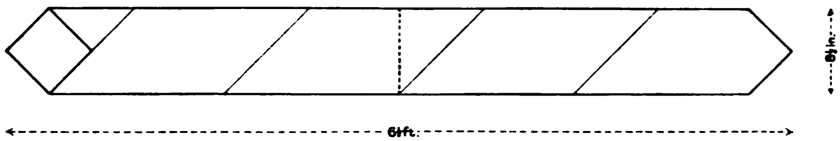


Fig. 26.—Japanese holdall (diagrammatic).

Very recently an entirely new equipment has been introduced, which I fully described in vol. xviii, p. 531, of this Journal.

Japan.—This country uses a small knapsack made of cowhide (fig. 13, No. 8) shaped over a removable wooden frame. It contains no divisions except a pocket in the flap. It resembles in many respects the present French pattern. The attachments of the braces to the upper edge and below are the same as in the French type. The front end of the brace carries a hook which engages the waist belt from below, the usual counter-strap attached to a stud on the main brace passes under the arm and hooks on to the lower edge of the knapsack. The mess-tin is secured to the flap by a strap similar to the load strap of the French.

During the later stages of the war in Manchuria, rucksacks were tried, but were not considered satisfactory.

The greatcoat, tent-piece, with the accessories and a pair of boots, are also secured to the outside of the knapsack. When these

articles are discarded, the blue or khaki cloth holdall (*seoi-fukuro*), carried by each man, takes their place. The hold-all takes the form of a sack 6½ ft. long but with both ends open; it is 8½ in. across when laid flat. One pattern is made of blue drill doubled, and is sewn across the centre so as to have two long compartments. If an action is pending the knapsack is discarded. The emergency rations are transferred to one of the compartments of the holdall, and the other compartment is filled with ammunition, sometimes over 200 rounds being carried. Thus loaded it is slung over the right shoulder, the loose ends tied under the opposite arm. Over the other shoulder the greatcoat is carried *en banderole*, with the entrenching tool and canteen secured to it [34] (fig. 26).

TABLE III.—Knapsacks at present in use.

Country	Height in inches	Width in inches	Depth in inches	Weight in lbs.	Remarks
Great Britain ..	14·5	12·0	4·7	2·2	
France	10·6	13·4	4·7	3·9	
Germany	12·4	12·0	3·5	3·3	
Austria	10·5	12·0	2·5–5·5	3·8	
Russia	14·5	12·2	5·5	2·7	Haversack.
,, ...	17·5	10·7	3·0	3·7	Guards' knapsack.
Italy	12·0	12·0	5·0	3·1	
Norway	18·0	16·0		4·7	Width at bottom of rucksack.
Sweden	13·4	12·0	4·0	5·1	
Japan	10·5	11·5	4·2	4·6	
America	27·0	8·0	6·0	0·7	Dimensions when packed.

Note.—Weight includes braces and all straps.

I have to thank Mr. Gibbs (late serjeant R.A.M.C.) for the great trouble he took in taking the numerous photographs which illustrate this article.

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VACCINE TREATMENT IN SUBACUTE AND CHRONIC ARTHRITIS.

By Captain P. C. T. DAVY.
Royal Army Medical Corps.

The whole subject of the pathology of arthritis still remains in the melting-pot, in which it has long since been cast by the bacteriologist. Though rheumatic fever still remains a true clinical entity, we must, if we are honest, regard "chronic rheumatism," "rheumatoid arthritis," and "rheumatic gout" as mere names with which we cloak our ignorance or satisfy the importunities of our patients. It must have been the lot of most of us to find that the text-book signs which so sharply define the numerous varieties of inflammatory joint disease one from another fail us utterly in practice.

The published evidence is daily accumulating that a very large number of these cases, whether monarticular or polyarticular, are merely the outward and visible sign of an inward, perhaps distant, and probably obscure focus of bacterial activity. These cases might be termed metastatic or toxæmic arthritis, according to whether an organism is found actually present in an affected joint or not. The activities of the gonococcus in this direction are too familiar with us all to be overlooked. The typhoid joint and the pneumococcic joint, if more rarely seen, are yet well-established facts. There would appear, then, to be no valid reason to deny the possession of similar powers of mischief to any micro-organism, either by actual metastasis or through its toxin. In the former cases the process is of a more fulminating character; in the other cases (those I am more particularly dealing with) the process is more insidious, as the original focus of bacterial activity is of greater chronicity. Collateral evidence is found in those cases of joint trouble associated with stercoral intoxication, or with perverted metabolism—itself perhaps, the outcome of a faulty intestinal flora. Here an improvement is wrought by addressing ourselves to the intestinal conditions. This affords the explanation of the striking results that have followed surgical interference. It is probably also to these cases that guaiacol and its salts and other intestinal antiseptics owe their reputation as anti-rheumatic remedies. The association of oral sepsis with arthritis has been much insisted on—notably by Lyon-Smith in the *Glasgow Medical Journal* last year.

The two cases which are quoted below, and which bear somewhat upon this point, came under my care within the last two years.

Case 1.—A young Indian man came to hospital complaining of pain and swelling of the wrist and phalangeal joints, and, to a less extent, of both elbows. The duration of these symptoms was over three months. He had been operated upon for suppuration of the antrum of Highmore about four months previously. The antrum had been opened in its lower wall by the intra-buccal route. A sinus remained at the time I saw him which discharged pus at frequent intervals. The laboratory reported a micrococcus "resembling *M. catarrhalis*" as the prevailing organism. A vaccine was prepared from this and ten injections of progressive doses were given at weekly intervals. Improvement of the joint condition was apparent quite soon. At the end of the treatment all the joints were normal. Three weeks later he was in excellent condition. The sinus had ceased to discharge and was apparently closing.

This case did not hold out any great hopes at the outset. The man had swallowed large quantities of sodium salicylate with no benefit. The result quite exceeded expectation.

Case 2.—Mrs. B., a lady, aged 42, of very active habits, who played golf and tennis and hunted, came under my care in May last year for "chronic sore throat and discharge from the nose."

Previous History.—She had had some ear trouble in girlhood. She had always been subject to sore throats, especially since she had a very bad ulcerated throat nine years ago. There is a certain amount of evidence that this particular illness may have been true diphtheria. The present attack she attributed to inhaling dust during a long railway journey in the Punjab.

The condition first seen resembled what is usually known as a "smoker's throat." There was also a free discharge of muco-pus from the posterior nares; but in the early morning the passages were found completely blocked and were cleared with great difficulty. During the day a large amount of purulent material was expelled from the naso-pharynx and both nostrils equally. The nostrils were patulous, and the mucous membrane swollen and turgid. Posterior rhinoscopy revealed a large amount of muco-pus coming from high up in the post-nasal cavity; the seat of the trouble appeared to be in the ethmoidal cells. The condition was attacked by frequent irrigations with the usual solutions, paintings and gargles. The improvement was but slight.

In July—some seven weeks later—she developed "rheumatism" in the wrists and fingers, and to a less extent in the elbows. The

joints were exceedingly painful to touch and on movement, and there was marked swelling. All the phalangeal joints were fusiform in shape and trophic changes in the skin and nails developed. The knees also were occasionally affected. There was an irregular, persistent pyrexia ranging between 100° and normal, but sometimes remaining slightly elevated throughout the twenty-four hours.

This condition persisted with little change for about two months. Salicylates and aspirin were given freely and relieved the pain, but had no effect on the temperature. Guaiacol, the iodides of potassium and iron, tonics and dieting were tried with no effect. The condition on the whole became gradually worse and the prognosis most gloomy. The patient could neither dress herself nor write, and she appeared to be drifting into chronic invalidism, with Buxton or Bath as her ultimate destination. The condition so far favoured the accepted description of chronic rheumatism rather than arthritis deformans, in that joints improved and relapsed successively, and that there was no bone change.

In September cultures were made from swabs taken from the post-nasal cavity, the laboratory reporting a "diphtheroid bacillus." She received eleven injections of a vaccine prepared from this, in doses increasing from 100 million to 1,000 million bacilli. The larger doses gave rise to malaise, a slight rise of temperature, and some local reaction. There was definite improvement after the third injection. This was steadily maintained. The nasal condition improved *pari passu* with the articular. When the injections were stopped both were normal.

I have quoted this case at some length, because I not only had it under close observation from the outset but have been able to follow it up.

She wrote some months later: "The inoculation completely cured me, and it cured my throat. Nothing comes away from my nose. . . . I never have any pains. . . . I can take heaps of exercise as of old." I have lately heard that there has been no relapse.

The above observations, of course, make no sort of claim to originality; one fears rather to be held guilty of stating platitudes by those more in touch with recent literature and progressive thought. I recognize also that as no attempt was made to cultivate an organism from the joint, nor to take opsonic indices, the cases quoted may have no scientific value but from the clinical aspect; they may perhaps be considered of sufficient interest to warrant record.

THE ORGANIZATION AND DISPATCH OF RED-CROSS "UNITS" TO THE SEAT OF WAR.

By Colonel JAMES MAGILL, C.B.
Organizing Secretary, British Red Cross Society.

On the outbreak of hostilities in the Balkans, the Council of the British Red Cross Society, at a special meeting, determined to send medical assistance to each of the belligerents, and placed the arrangement of details in the hands of the Executive Committee.

As the invested funds of the Society are only available for wars in which British troops are engaged, an appeal for subscriptions was made in the press, and a generous response was the result.

The Executive Committee subdivided its duties thus: Two gentlemen were responsible for the selection of the personnel; two others arranged all details connected with equipment; while the financial side of the work was managed by the chairman and the non-professional members.

The Governments of all the belligerents gratefully accepted the offer of the British Red Cross Society (made on October 8) to dispatch assistance, and the Foreign Office sanctioned the proposal.

The Society appointed three "Red Cross Directors" to supervise the work of the parties it was proposed to send to the seat of war, viz., Surgeon-General G. D. Bourke, C.B., for Bulgaria, Servia, and Montenegro; Colonel C. Delmé-Radcliffe, C.V.O., C.B., C.M.G., for Greece; and Major C. Doughty-Wylie, C.M.G., for Turkey.

The composition of a Red Cross "unit" was as follows: 3 medical officers, 3 dressers (fourth or fifth year students), 6 nursing orderlies (one as sergeant), 5 general duty orderlies, 1 cook. Total 18.

Men "in waiting" were also held in readiness to take the place of any "casualty" prior to departure.

When practicable, a Royal Army Medical Corps officer was placed in command, special sanction having first been obtained from the Army Council. The dressers were selected from the same hospital if possible. Most of the nursing orderlies were "trained sick attendants" (ex-soldiers of the Royal Army Medical Corps, who were no longer in the Reserve, and who had left with a "very good" character).

The "General Duty Orderlies" also included many men who had served in the Army, and a few from voluntary aid detachments of the British Red Cross Society.

The scale of pay was as under: Director, £2 a day; Surgeon, £1 a day; Dresser, £2 a week; Nursing Orderly, 30s. a week; General Duty Orderly, 25s. a week; Sergeant, 40s. a week.

In addition each person, when not rationed, received 5s. a day "in lieu."

Each candidate, if a doctor, filled up a card with the following particulars, among others: Name, age, qualifications, war experience, how at present engaged. What foreign language do you speak? Can you ride? Are you willing to be inoculated against enteric? Have you lectured or examined for this Society? With which belligerent do you prefer to serve? Present address.

The card for nurse, dresser, or orderly was slightly different: Age, name, training received, war experience, present occupation. Have you been a member of a Voluntary Aid Detachment? What foreign language do you speak? Can you ride? Are you willing to be inoculated against enteric? Have you been vaccinated? Reference.

As soon as the candidate had been inspected by the Committee and approved, he was measured for his uniform, consisting of a cap (khaki), jacket (khaki), greatcoat ("warm British") and Balaclava cap, breeches and putties, trousers, gloves, and belt.

He was provided with an "identity disc," a pair of ankle-boots, and a pair of india-rubber boots also.

Before embarkation he received the following articles: Brassard; haversack (fitted); mess-tin (cavalry); water-bottle; clasp knife; sweater (or knitted waistcoat); flannel shirts, 3; socks, 3 pairs; drawers, 2 pairs; first field dressing, 1; blanket, 1, and waterproof sheet, 1 (in which to roll the above).

The following equipment (medical and general) was provided for each "unit": Field medical panniers (1905), 1 pair; field surgical panniers (1905), 1 pair; field medical companion (1905), 1; surgical haversacks (1905), 3; field fracture box (1906) with Hodgins's splint, 1; reserve dressing box (specially arranged); special case, containing iodine, chloroform, carbolic acid, opium, marine sponges, &c.; medical comfort pannier, 1; panniers ("field ambulance"). "A. to H."; filter (Berkefeld), with spare candles; flags; camp kettles, with contents, 2; stretchers, 4; brassards (total for unit), 50; first field dressings (total for unit), 50; tabloids, acid, sulphate of soda; and blankets (total for unit), 50.

A varying number of days' rations was taken by each unit, on a daily scale suggested by Colonel Melville, as under: Six large biscuits, one tin of beef (1 lb.), one tablet (tea), three Oxo tubes, salt, sugar, chocolate (¼ lb.), cheese (2 oz.).

In addition, before its departure each unit took over a large quantity of extra stores, varying in composition and amount, according to its destination, for example: Blankets, waterproof sheets, pillows, pyjamas, flannel shirts, socks, milk, Bovril or Oxo, pea soup, preserved meat, buckets, basins, urinals, bedpans, plates, cups, &c., cooking pots, extra dressings, operation gloves, operation gowns, special instruments, stovaine, vaccine lymph, disinfectants, invalid foods (various).

Each medical man received a copy of "R.A.M.C. Training," and Major Spencer's "Gunshot Wounds."

A considerable sum of money was handed to each Director, or officer in charge of the party, for necessary expenses *en route*, and on his arrival.

Each member signed a form of agreement undertaking to serve, if required, for six months, and was provided with a passport.

The Foreign Office furnished each party with a *laissez-passer*, thus facilitating the transit of the baggage through the different customs-houses.

On three or four occasions the units were lodged for a night or two previous to departure in Millbank Barracks, through the courtesy of Colonel Skinner—a privilege which was greatly appreciated by the Society. This officer also provided the antityphoid serum for the inoculation of all ranks.

In reply to numerous inquiries as to what gifts of articles of clothing, &c., would be most acceptable, a brief circular was issued. It met with an immediate response, and large quantities of blankets, pyjamas, flannel shirts, socks, &c., were received and duly forwarded. The goods were in bales, or boxes of moderate size, with a list of contents on the outside.

The first unit dispatched was sent to Montenegro.

On October 16, the Society received a letter from the Foreign Office, drawing attention to the fact that the Montenegrins had had heavy fighting, and were much in need of medical assistance; and the party left on the 19th, travelling to Trieste, via Flushing and Cologne, and taking stores—medical and general—besides their personal equipment.

The officers of the unit were: Drs. Bradford, Martin-Leake, V.C., and Goldsmith; and Surgeon-General Bourke, the Red Cross Director for the three Balkan States, with an interpreter, accompanied the party.

From Trieste, the unit was conveyed in an Austrian-Lloyd steamer to Cattaro, and on to Antivari, at which port the Monte-

negrin Government desired the establishment of a hospital in view of the fighting round Scutari and Tarabosch.

Suitable premises were obtained in a tobacco factory, while the personnel were lodged in a house belonging to the Crown Prince. As little could be procured locally, various articles of hospital equipment deemed necessary were obtained from Trieste and from Bari on the opposite side of the Adriatic; additional stores were forwarded from London, with as little delay as possible.

An Advanced Post was established at Pentari, and did valuable service; while attempts were made to transport wounded down the Boyana River, and from its mouth round to Antivari.

Subsequently a small party was sent to Rjeka, and another to St. Nicola, and thence on to S. Giovanni di Medua. The local military authorities promised to provide food, but difficulties arose.

On November 11, in response to urgent representations, the Society dispatched six trained female nurses, three orderlies, and supplies, as Dr. Bradford anticipated a large influx of wounded. (It may perhaps be mentioned that this was the only occasion on which a Red Cross Director applied for female nurses to be sent out by the Society.)

The weather increased the ordinary difficulties of transport, which at best were most formidable. The tracks, soon converted into deep mud, proved absolutely impracticable for the conveyance of serious cases.

The daily routine was disturbed on November 2 by an explosion in an ammunition store.

Two members of the unit did very excellent work in removing the injured from the burning building.

Up to date, November 25, the number of cases treated at Antivari and the other posts was: In-patients, 547; out-patients, 237.

The next party was detailed for Greece and started on October 27. It consisted of two "units," *i.e.*, six doctors, six dressers, twenty-four other ranks, and an interpreter. Colonel Delmé-Radcliffe, C.V.O., C.B., C.M.G., lately Military Attaché at Rome, an officer of great linguistic attainments, who had taken a leading part in the relief work subsequent to the Messina earthquake, was Director; and Major Houghton, R.A.M.C., the Senior Medical Officer.

In addition to the equipment (personal, ordnance and medical) previously referred to, this party took out a large quantity of food of various descriptions, and miscellaneous stores, of the value of about £500. An unfortunate occurrence took place *en route* and all the

baggage was detained temporarily at Salzburg, owing to the blunder of a station-master. So the "units" arrived at Trieste, and embarked on board the Austrian Lloyd boat, without their equipment. A medical officer and an orderly had to be left behind to bring it on by the next steamer. The consequences of this mishap were very grave.

Two days subsequent to the arrival of the "units" in Athens (*i.e.*, on November 4) application was made by the authorities that the entire party should embark in the hospital ship "Albania" and proceed forthwith to a place in the neighbourhood of Salonika, then closely besieged.

With the greatest difficulty, and at an exorbitant cost, certain necessary surgical and medical stores were procured locally.

Eventually Salonika was reached, the city having been captured in the meantime; and on November 10 the medical officer left behind arrived there with the original equipment, and a hospital was allotted to the British Red Cross.

The last report from Salonika is dated November 22; the Red Cross units occupy the Turkish Municipal Hospital, which is a well-designed building, but very defective in its sanitary arrangements. The Director reports that since they opened the hospital on the 13th "they have been working all day and night, and all sleep on the stone floors." The hospital will hold 250 patients, but at the time of writing there were no less than 585 sick and wounded crowded in the building. "They have to be placed in the corridors, landings and wall spaces." "The sick and wounded are dumped down in the hospital without warning at any hour of the day or night and their condition is pitiable. Last night we had thirty-four suddenly brought in." Eight hundred sick and wounded have just been transferred by steamer to Athens. Major Houghton and a lightly equipped party are (November 18) on their way to Vodena where a battle is expected to take place between that town and Monastir. A rest camp is being formed for all those patients who are suffering only from starvation and exhaustion, so as to relieve the greatly overcrowded hospital. The Director adds: "The whole party are as good a lot as one could wish for, and they are earning golden opinions."

There is a vast amount of destitution and suffering among the thousands of refugees, who have crowded into the city, a condition of things which the Society is doing its utmost to combat.

Major Doughty-Wylie, C.M.G., an officer of large experience, and an accomplished Turkish scholar, was appointed Red Cross

Director for Turkey. He had, while Vice-Consul in Asia Minor, rendered conspicuous service at the time of the massacres at Adana (1909). He was accompanied by his wife, who had been prominently connected with hospital work in Bombay and elsewhere.

The party consisted of three "units," viz., nine medical officers, nine dressers and thirty-six other ranks, with an interpreter. The stores were supplied on a liberal scale, the ordinary equipment being supplemented by an extra amount of food and hospital requisites to the value of over £300. Mr. Page, F.R.C.S., who was the Senior Medical Officer, as well as several of the surgeons and dressers, came from St. Thomas's Hospital.

Leaving London on October 29, they travelled by way of Calais and Paris and embarked from Marseilles on a steamer of the Paquet line. (Through the good offices of the French Ambassador, the French railways most kindly allowed the Society a rebate of 50 per cent. on the fares, a reduction also obtained from the S.E. & C.R.).

Constantinople was reached on November 5, and next day Major Doughty-Wylie took over the Fine Art School (Museum) near Seraglio Point, Stamboul, "a fine airy and clean building with boarded floors," and established a hospital forthwith for ninety beds. The completion of the water supply was the first necessity; then a kitchen had to be constructed and gas introduced. Food was promised by the Turkish Government, but they found it impossible to supply it regularly.

On this date, November 6, it is noted that there is no enteric reported at present in the town, but there are cases of small-pox, and of suspected cholera.

(It may be stated that during the voyage out each member of the party had been re-vaccinated, and also inoculated against typhoid fever.)

On November 7 Major Doughty-Wylie reports that stretcher parties went to the railway station at 8 a.m. to bring up wounded.

"We found the sheds under a sentry, as it was thought that there were cases of cholera. But entering, Mr. Page picked out some cases of wounds which he considered non-suspicious and we carried them up. . . . One man had some wooden splinters behind the eye for twelve days, and all were short of food. The military authorities have sent us a few more cases, but much fewer than we hoped for.

November 8.—"About midnight last night a convoy of wounded came in, and the staff were busy till 3 a.m. . . . The medical

officers report that the wounds had not been touched for twelve or more days and that they were in some cases full of maggots."

Major Doughty-Wylie now favoured the idea of pushing one of his units to the front, and improvising a hospital train, and Colonel Hawker (of the Gendarmerie) was good enough to visit Nazim Pasha's camp and to bring back a grateful reply.

November 9.—A suggestion was made and speedily carried into effect that one of the Red Cross units should open a small hospital at Vehfa, some two miles from the Fine Art School, and that another should go to the front; while one surgeon was detailed to help Dr. Clemow, the Medical Officer of the Embassy. Mrs. Doughty-Wylie arranged for the provision of a number of Turkish-speaking female nurses, partly from the American College and partly from the Ottoman Red Crescent Society.

It is noted that ten operations were performed that day.

On November 12, Major Doughty-Wylie, accompanied by Drs. Page and Anderson, went to San Stephano in a tug-boat and decided to take over next day a house on the beach, and to instal Dr. Anderson's unit.

On returning in the morning it was found that this house had in the meantime been turned into a Cholera Hospital, and that it and its grounds were surrounded by a cordon of soldiers. So the unit went back to the Fine Art School.

On November 15, a regiment from Asia Minor landed at Seraglio Point, stricken with cholera. "They were in the worst stage, confused, helpless men, dead and dying in every direction, the survivors not strong enough to carry their comrades—the news of the scene was sent to the hospital in the museum which is about five minutes away, and the whole staff headed by Mr. Page turned out on their own initiative to help by carrying the sick from the pier to the railway station appropriated as a hospital. They carried dying men till dusk. Every precaution to disinfect men, short of burning their clothes, was taken."

In order to establish a temporary hospital, or advance post, in the neighbourhood of the area of active operations, Major Doughty-Wylie took the following steps :—

"A glance at the map of Chatalja lines will show San Stephano immediately east of a lake running in the direction of Nazim Pasha's headquarters. There was in the map a water connection between sea and lake, with a bridge over it, and it was suggested that this water-way might be utilized for bringing down the wounded." . . .

There were difficulties, however, as the sea at San Stephano is sometimes high, and the channel between there and the lake is very shallow and readily silts up.

With the permission of the Commander-in-Chief, the British Red Cross Society established a hospital at Chiftlik on the lake, and will thus be able to offer organized help to the wounded near the battlefield should hostilities recommence. Dr. Anderson was in medical charge, and his unit and its equipment were duly installed there. Five patients, including three officers, were soon admitted, all recently wounded.

Major Doughty-Wylie gives a striking account of the horrors of the trains going to Stamboul :—

"They are absolutely crowded, and men sit and lie on the roofs and on the buffers. On one train which passed us men who had died in the carriage were lashed to the footboard. Everybody who can move among the sick at Hadim Keui staggers or crawls to the train and climbs on board. Many die in it, and some are taken off at every station. And these dreadful trains carry the disease to crowded Stamboul every day."

As soon as the reports of the state of things in Constantinople reached the Society, every effort was made to dispatch assistance on a generous scale. Large financial aid was telegraphed, but there were great difficulties in getting steamships to accept freights.

However, on November 20, ten tons of stores (including five tons of food, for the sick and for the sound, of the value of £300) were sent, via Marseilles; and on the 26th the party in Turkey was supplemented by the dispatch of three medical officers (Captains Horton, D.S.O., I.M.S., Smallman, and Lloyd-Jones, R.A.M.C.), two dressers and seven "trained sick attendants." These officers had had experience of cholera epidemics, and Captain Smallman was especially selected as a bacteriologist and was provided with apparatus for research. Through the courtesy of the Lister Institute he was furnished with certain sera, while the Royal Army Medical College kindly gave him a supply of material for antityphoid injection. Large quantities of chloride of lime, perchloride of mercury, cresol, carbolic acid and formaldehyde have also been shipped.

Writing on November 27, the Director reports that along with such members of the personnel as could be spared, and who volunteered for the service, he proceeded to render assistance at the Cholera Hospital at San Stephano, taking with him a quantity of stores.

Major Ford (a medical officer of the United States Army), assisted

by half-a-dozen others (men and women), had been working there for four days, with unflagging devotion. "The worst spot is the Greek School, where were crowded together in four small rooms no less than 347 patients still in the clothes they had worn since the beginning of the campaign. . . .

"The crowd, the irremediable filth, the ghastly difficulty of doing anything, can never be realized by those who had not seen it. . . . Our people turned to, and helped to feed and tried to clean. Doctoring was out of the question for the moment, and from the first it was plain that we must get a camp going. . . . They had not all got cholera; many had dysentery, and many gangrene of the feet; some seemed to have erysipelas, and some probably typhus."

Tents were procured, and speedily pitched on a piece of clean ground on the edge of the small cliff over the sea, and close to the Greek School. Mattresses were obtained, latrines were dug, and refuse-destructors were erected.

Help was forthcoming from various nationalities. The Director's final note (on November 29) is — "things were a little more cheerful."

Two Red Cross units left for Bulgaria on November 3.

Major Birrell, R.A.M.C., was in command of "No. 1" (the initial expense of which was contributed by the county of Sussex), and associated with him were Captain Byam and a civil surgeon.

The usual stores accompanied the party, and in this case the extra supplies were chiefly medical and surgical.

Major Birrell took with him an X-ray apparatus, provided by the kindness of his personal friends, and the Society furnished him with an operator (Mr. Cox).

"No. 2" was originally raised under the auspices of the "Balkan War Relief Fund," but the British Red Cross Society was asked to take it over.

This it did, undertaking "to arrange your expedition to Bulgaria in conformity with our system of units, and to engage such of your personnel as we think suitable."

Major Hudson, D.S.O., I.M.S., was therefore appointed in medical charge, and stores, both medical and general, were added to the original equipment.

The two units, after a very brief stay in Sofia, proceeded to Kirk Kilisse.

Writing from Lozengrade (Kirk Kilisse) on November 26, Major Birrell reports as follows: "We opened to-day a hospital

taking in ninety-four wounded from Chatalja, all septic, from fighting six or seven days ago. We can take in 188 in the two buildings given us, and have no pressing needs."

Servia was the last of the belligerents to which the British Red Cross Society furnished assistance. Two units were sent out, "No. 1," due to the liberality of Wales, was placed under the command of Captain Carter, R.A.M.C., and started on November 12.

"No. 2" was raised in, and financed by, Scotland.

Major Douglas, V.C., D.S.O., was the medical officer in charge. It left on November 16, taking with it, in addition to its own equipment, supplementary supplies (medical and general) for our two units in Bulgaria, to be forwarded, under the charge of a special attendant, if practicable. The smartness of this party was noteworthy.

Both units arrived duly in Belgrade and in a few days left for Uskub. Here they were asked by the Servian medical authorities if they would like to go on to Monastir, where there was a large number of sick and wounded needing attention. This was agreed to at once, but eventually the move was cancelled.

At Uskub, therefore, a hospital was established with accommodation for 112 cases, and on November 27, fifty-nine wounded were under treatment. The Government supplied food and such additional equipment as was necessary, as well as "certified brassards."

As already mentioned, Surgeon-General Bourke, in the first instance, accompanied the party for Montenegro. Subsequently he left for Sofia to meet the units detailed for Bulgaria, and to give them the benefit of his assistance. This done, he travelled to Belgrade, where the parties for Servia were expected, and went with them to Uskub; and then back again to Belgrade. The duty of the "up-keep" of the stores, medical and general, of units so widely scattered, is a matter which must tax the best organizer, in such a country and at such a season of the year.

Total Personnel of Red Cross Units.

Three directors; 34 medical officers; 35 dressers; 1 X-ray operator; 9 serjeants; 2 clerks; 5 cooks; 49 nursing orderlies; 69 orderlies (general duty); 6 trained female nurses. Total 213.

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United Services Medical Society.

"THE CRUX OF THE MEDICAL PROBLEM IN WAR."

By Colonel BRUCE SKINNER, M.V.O.

It is not necessary to explain why it is that an army in the field melts away through sickness, why the accumulation of men in camps and bivouacs necessitated by war has been accompanied invariably by disease, usually of epidemic proportions. We recognize this fact, and so do most trained staff officers. We also know that the application of modern knowledge of sanitation has led to a diminution of sickness, and will always lead to a similar diminution in our future wars; but we cannot expect to be freed entirely from it. Consequently, provision must be available to meet that contingency, and also to dispose of the periodic accession of wounded. We start, therefore, on the principle that the field force must be provided with medical arrangements adequate to dispose of the sick and wounded.

Now the mobility of an army is influenced by the amount of transport requisite, by the amount of food procurable, by the amount of sickness among the troops, and by the necessity of guarding supplies, as well as medical units occupied by the helpless. Any organization and method of administration which will reduce these factors making for immobility, will obviously increase the mobility of the striking force. For this reason it behoves us army doctors to study war, in order that we may be educated to a ready grasp of the design of the Field Commander, and be able to exercise a trained imagination. Our trained imagination will foresee and prepare for situations where special concentrations and dispositions of medical units will be necessary. Failure to exercise this trained imagination has led, and will always lead, to failure in medical arrangements, even though material be ample.

For instance—in Indian warfare, a medical unit cannot be left unguarded; and if such a unit in the front line has become an extemporized hospital, the force becomes crippled by the necessity of furnishing a guard or garrison for its protection. And this may so seriously diminish the force as to render it unable to give effect to the will of the Commander. Consequently we realize that the medical units in the front line must be kept free from sick. This can be attained only by free evacuation towards the base. This

principle is unassailable, though designs to give effect to it may sometimes be defeated. By the study of such failures, and by our own individual experience, above all, we may steer clear of similar lapses.

Hospitals in the field demand supplies which would go otherwise to support those men who are of the first importance at the front—viz., the healthy. And the supplies consumed by the sick are greater per man than those required for the sound. The fewer sick retained at the front the more supplies remain available for those who are useful soldiers. Again, the further back the hospitals can be retained the less distance will the supplies of equipment, personnel, appliances and food have to be carried, while the greater will be the technical utility of such units. And this, let me explain, is owing to the possibility of providing nurses as well as furniture and apparatus, and also articles of dietary which in the nature of things cannot be procured at the front. The true hospitals, then, must be on the line of communication, where such things may be obtained. The medical units in advance of them should contain but the strictest necessaries in the way of appliances, and should consist mainly of ambulance transport.

Then, again, the sick breed sickness. The maintenance of enteric fever cases in the midst of the healthy exposes the latter to infection. And for this reason, if for no other, the sick must be removed from the vicinity of the healthy. In this matter our modern knowledge has arrived at the result achieved by those lower animals whose instinct impels them to drive the diseased or disabled from their herds.

When Lord Roberts marched from Kabul to Kandahar in order to take the shortest route to the aid of the force which had been crippled by the disaster at Maiwand, he had to leave his base and carry all his requirements with him. His force of 9,987 picked men started from Kabul on August 8, 1880. The sickly had been weeded out. The sick transport was composed of 2,192 bearers and 286 ponies. This ambulance transport constituted one-third of the total number of followers, which was 7,000. Besides this there was the transport required for hospital tents and supplies. A diagram of the route is given in " Forty-one Years in India."

After a march of three weeks in hot weather this force arrived at Kandahar with about 1,200 men and followers in the hospitals. Of these, 940 were admitted into the General Hospital at Kandahar on August 30, 1880. The distance traversed had been just on 300 miles.

The sick transport already mentioned had to be augmented *en route* by requisitioning donkeys to supplement the transport in hand, which was sufficient for 650 men only. It is true that the Kandahar F.F. was increased by a small force picked up at Robat, but that force did not affect the case in point. In three weeks, during a march of 300 miles, 10,000 men required 7,000 followers, and ambulance transport was accumulated for over 7 per cent of its total strength. Yet that march was a fine performance, and the transport a great reduction on the amounts taken on previous Indian expeditions, the Commander being far in advance of his time. The number of casualties was not above what might have been expected. The reason for the accumulation was that there was no line of communication where the incapacitated could be dropped. Had it been possible for that force to have moved within touch of communications it could have dispensed with at least half its ambulance transport, which means that there would have been 1,100 fewer doolie bearers to feed, and correspondingly less impedimenta.

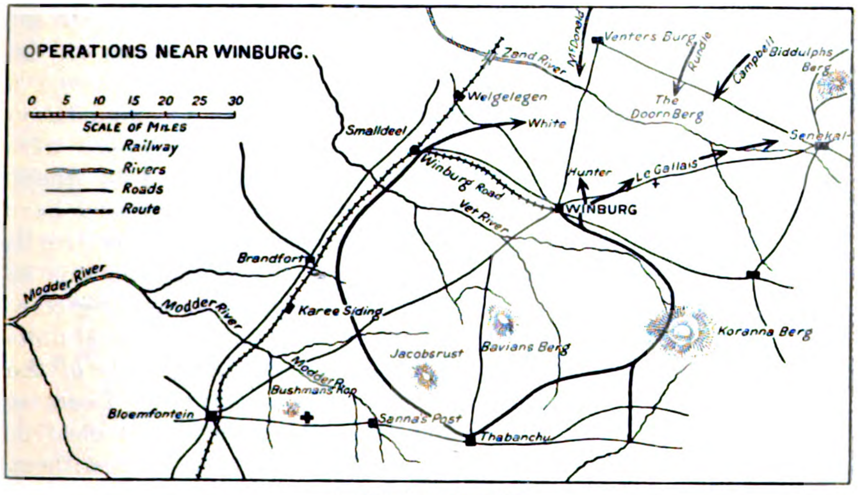
This famous march illustrates how an expedition has to be encumbered with sick transport when detached from its base, and conversely that a striking force in touch with its base may lessen its own ambulance transport. An incidental point which has not been referred to above is that a force may carry on with but a small amount of ambulance tentage. For only one field hospital accompanied the force for British troops, and on many occasions the tents did not arrive until a few hours before the column had to march again. The tents, therefore, were little more than incumbrances.

On one occasion, during the earlier part of the South African War, General Sir A. Hunter commanded a force of 5,000 men marching north from Thabanchu to operate to the north of Winburg.

At Thabanchu was a small hospital of twenty-eight beds belonging to the line of communication, to which a field hospital provided with some ambulance wagons was added for the occasion. Thabanchu was connected with Bloemfontein by ambulance posts at Sannah's Post and Boschman's Kop. During the assembly of General Hunter's force the sick were passed down in a steady stream to Bloemfontein by daily stages.

On September 11, 1900, a column 1,000 strong, under Colonel White, left Thabanchu for Brandfort to work to the west of the Doornberg. This column discharged its sick *en route* at Brandfort and Smalldeel.

On the 12th General Hunter left Thabanchu at 9.30 p.m. His medical units were of the slenderest, so three ambulance wagons were lent to his P.M.O., as he would be detached from his communications. This column was joined the next day by the 21st Brigade, and Colonel Le Gallais' M.I., bringing the strength up to about 9,000. On the 16th this force passed near Winburg, and was relieved of its sick by the S.M.O. at Winburg, who sent ambulance wagons out to meet the column and to bring in its sixty sick, which had accumulated in less than five days.



+ Clearing Hospital.
-+- Rest Hospital.

The diagram shows the position of the columns, including those from the north, on the 17th, trying to surround the Boers on the Doornberg. On that day General Rundle had a successful engagement with the Boers, who slipped away eastward along the Zand River. On the 18th the columns closed inwards, and on the 19th they dispersed in various directions—Generals Hunter and Rundle, with Colonel Le Gallais, going to Senekal.

Now, to go back to the field hospital at Thabanchu, it had to remain there till the 14th, in order to dispose of the sick received from the column. It then marched with its ambulance wagons via Brandfort to Winburg, where it arrived on the 17th. On the 18th it arrived early—a day's march about sixteen miles out of Winburg, where it received the sick of all the columns, passing them back to Winburg by wagons sent out from the camp. It is

clear that if this arrangement had not been made, the columns would have had to carry their own sick back to Winburg, and would have been detained two days in consequence. The field hospital remained in this position as a connecting link with Senekal until General Hunter's operations there were completed; for Senekal was not then in a position to afford hospital accommodation to the sick.

Winburg formed a clearing hospital for this force. It possessed accommodation for 134 sick officers and men. A hospital train due there on the 17th was late. The hospital was expanded to deal with the 7 officers and 170 men who were under treatment on that date, including the 60 sent in from the columns on the 16th. On the 18th the hospital train arrived, and removed 6 officers and 90 men, leaving Winburg with ample accommodation to meet the requirements of the next few days. There were actually remaining in hospital on the 18th 1 officer and 53 others.

In order to reduce their baggage, the columns had, as I have said, but scanty provision of sick transport. This narrative is given as an illustration on a small scale of evacuating the sick as speedily as possible, the line of communication units keeping close touch with the columns in order to keep the column medical units as unencumbered as possible, thus maintaining the mobility of the forces. These forces might have been engaged with the Boers at any time, and if their ambulance wagons had been detached in convoying sick, the combatants would have been left without medical aid, and the columns would have had to await the return of the ambulance wagons. The point to be learnt from this is that the line of communication units should evacuate the sick and wounded from the field units—the field ambulances of which should always be ready to march with their column as soon as the Commander desires to move on. It is clear that this cannot be effected unless the line of communication units have command of ambulance transport—a point to which I shall return later.

But I think it may interest you if I note the machinery by which the above arrangements were worked. There were two "gods" in the machinery, one the I.G.C., the other the G.O.C. column; each of these was represented for our purposes by a D.D.M.S. or A.D.M.S. You will observe that I am using modern terms now. For the purposes of this sketch we will speak of the D.D.M.S. and A.D.M.S. as representing the Generals. The D.D.M.S. of the line of communication arranges a stationary hospital at Thabanchu, and supplements it with a field ambulance to do

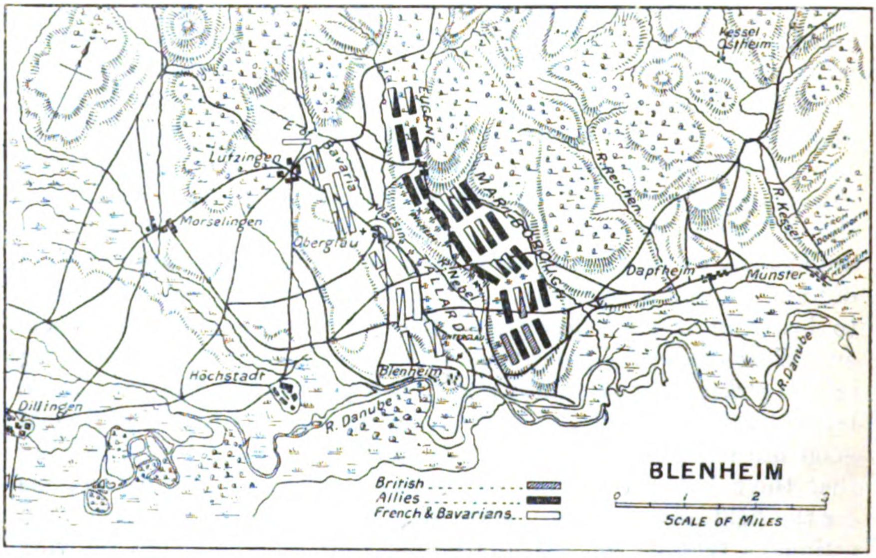
necessary transport and clearing work. The A.D.M.S. of the column is requested to evacuate all his sick to Thabanchu Hospital, before moving off for which, you remember, three ambulance wagons were lent to him. The line of communication arranged the posts and the ambulance service from Thabanchu to Bloemfontein. The column moves off; D.D.M.S. line of communication having requested the A.D.M.S. column to helio Winburg, when in touch with it, to tell them where to meet his sick, and informs him that line of communication will keep touch with him on learning later movements. D.D.M.S. line of communication orders the field ambulance at Thabanchu to evacuate as fast as practicable after the departure of the column, and then to march as rapidly as possible to Winburg via Brandfort, refilling there, and to be guided at Winburg by later instructions. He warns Brandfort to be ready to meet requirements of the field ambulance about such and such a date. He also warns Winburg to be ready to send out ambulance wagons to bring in sick from the column about a certain date on learning its whereabouts from the A.D.M.S. column; and, secondly, upon arrival of the field ambulance, to direct it to take up a convenient post a day's march out and behind the column, sending its ambulance wagons forward to bring in sick whenever A.D.M.S. column intimates the need, and Winburg sending out wagons to the field ambulance to bring in the sick from that unit; and, thirdly, informs A.D.M.S. column later of this post and the instructions given to it, which will hold good until the column removes to a new position. Later, hearing that the column is moving to Senekal, he gives fresh instructions for the field ambulance to work with it until the A.D.M.S. column intimates that he has no further need for it, when he is moving into another section of the line of communication.

While this is going on the I.G.C. and his staff are stationary at Bloemfontein at the end of the signal line, while the G.O.C. column intimates its moves by visual or other signals to I.G.C.

I will not take any further examples from that campaign at present, though we shall have to cull some lessons from it. I should like to draw your attention to an epoch-making battle of two centuries back. I refer to Blenheim, and although the date of its action is remote, it appears to me to offer some interesting points. Although armies in the present day fight, or rather manœuvre, on a broad front, there is always a point whereon one side concentrates his effort. We can realize that in some cases such concentration might be opposed by similar concentration, and in such a case we might have a situation not dissimilar to this Battle of Blenheim. And we may learn from it the value of prompt evacuation.

Broadly the battle may be sketched as follows :—

A position held by the French and their allies—45,000 French, 15,000 Bavarians—extending for four miles northward from the Danube, through the villages Blenheim, Oberglau, and Lutzingen. Marshal Tallard commanded on the right, holding Blenheim in great strength, and extending northwards to Oberglau where Marshal Marsin commanded the centre. On Marsin's left was the Elector of Bavaria holding Lutzingen. In front of the position was the Nebel, a stream flowing through a marsh.



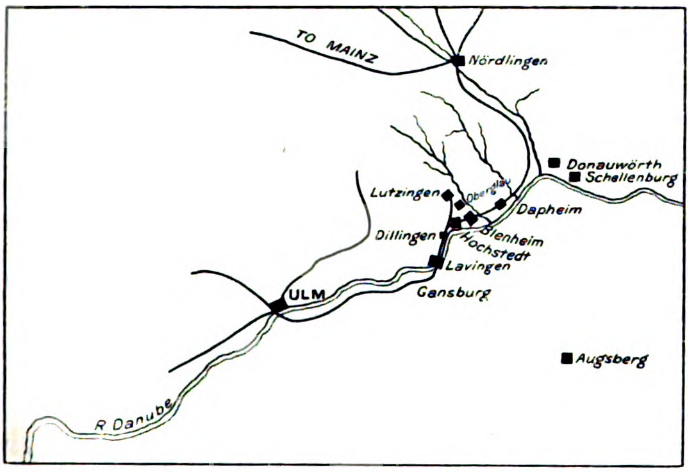
Adapted from vol. vi of Fortescue's " History of the British Army."

On August 13, 1704, the Allies crossed the Kessel, the left being under Marlborough, to attack from Oberglau to Blenheim, the right under Prince Eugene, from Oberglau to Lutzingen. This army consisted of 52,000 men, of whom 16,000 were British. The morning was foggy and Tallard did not think that Marlborough contemplated an attack; consequently, when the fog lifted he was surprised to find his opponent deploying in front of him on the opposite side of the Nebel, and his outposts being driven in.

Blenheim and Oberglau, where the French artillery was massed, were too far apart to permit of fire from their guns reaching the crossing of the Nebel midway between.

Marlborough opened by putting his left up against Blenheim,

while he himself moved down to the relatively dead ground on the Nebel, where he proceeded to cross. The attack on Blenheim was but partially successful, and Marlborough told its Commander to hold his ground merely, while he himself forced his way across the stream. This he accomplished after some hard fighting, destroying the French centre and isolating the defence at Blenheim. The cavalry of the French right were then put to flight, and Tallard was bottled up in Blenheim.



Blenheim—Lines of evacuation of sick.

Eugene meanwhile had been holding his own on the right, but produced no impression on the Elector. But Marlborough's destruction of the French centre caused the Elector and Marsin to retreat on Dillingen after burning Oberglau and Lutzingen. Eugene pursued, his hussars hanging on to the Elector's column as far as Ulm.

The French lost nearly 40,000 men that day, including 11,000 prisoners ; only 12,000 of that French army ever fought again.

The Elector carried off 7,000 wounded, retreating to Ulm, and later through the Black Forest, by forced marches.

The Allies lost 4,500 killed and 7,500 wounded, chiefly on the right.

Marlborough bivouacked on the field, marched a few miles west the next day, and on the 19th commenced his return march to the Rhine, leaving a force to besiege Ulm.

Now Marlborough's army had marched 600 miles from its base behind the Moselle to the capture of Donauwörth (Schellenburg) on July 2, 1704; he had entered Bavaria, which he saved to Austria, and had marched back on the approach of the French, to cover his communications, and by this victory saved Germany from the French.

What is the medical problem? There are the wounded of the Allies, the wounded of the French about Blenheim and Hochstedt, and the wounded of Marsin and the Elector which were carried off the field.

Marlborough was so burdened with this problem of the wounded that four days after the battle he wrote that he had no time for anything but to look after them. His nearest hospital was at Nördlingen, some twenty-eight miles to the north, where he had a commissariat depot, and where the wounded after Schellenburg had been treated. Note here that he would not treat his wounded in a captured city, but sent them out of the line of military operations. In those days surgical operations were freely performed on the battlefield, those who survived being subsequently carried off in wagons to the hospital; on this occasion they were placed in the tents left behind by the French and subsequently drafted off to Nördlingen. Arrangements were made with the magistrates there to look after them as they convalesced, they were billeted[1] on the neighbouring villages and subsequently carried to Mainz, whence they were floated down the Rhine, the Dutch to Holland, the British to England. This last fact gives an instance of water-borne evacuation, a system which could be used extensively in some parts of Europe. There appears on this occasion to have been *ample transport, but no medical organization* to relieve the general. Picture to yourselves the greatest strategist our country has produced having to spend four days after the fight in personally disposing of his wounded! But the fact remains that he had the transport and was able to deal with over 7,000 wounded of his own, besides the French, in four or five days.

As I have said, the conditions appear to me such as might hold in the event of warfare in this country; and let us picture to ourselves the above battle as having occurred in England to-day, Marlborough's (including Eugene's) army having been composed of regular and territorial troops. The D.M.S. would relieve the Commander-in-chief of all anxiety for the care of the wounded, and the latter would be disposed of much as follows :—

[1] Suggesting modern convalescent camps.

The line of communication hospitals or clearing hospitals and other medical units would have come up to the Kessel during the day of the battle. The country-side is dotted with villages, each having members of Red Cross organizations, most of whom would have fled from the villages held by the enemy. Possibly these villages would not be wilfully burnt, but would be much damaged; still there might be shelter, and the villagers would return as soon as they witnessed the flight of the enemy.

In response to the summons of the I.G.C. through his D.D.M.S. working through the chiefs of the Red Cross organizations, the Red Cross units would be prepared to act on posts along the line, and to provide convoy corps and hospital detachments.

The line of communication clearing hospitals would come up and take over the wounded from the field ambulances. They would place certain cases in the villages about. They would transfer others to a general hospital or to rail-head by means of convoy corps, and, I hope, by means of specially arranged sick transport. Thus the field ambulances of the division would be rapidly freed to march with the troops as soon as the latter had got over the exhaustion of the fight. The line of communication would have become responsible for the disposal of the wounded. And remember the Red Cross organizations exist not only along the line of march but also laterally. Upon the call of the D.D.M.S. line of communication they would come in from the villages on each flank and remove such cases as were committed to them to homes and hospitals over a much wider area than would be available to a force fighting in an enemy's country. The only point I should like to know about these convoy corps is whether they are trained to keep an accurate record of the wounded they dispose of.

To return to classical Blenheim :—

The most surprising performance in respect to the removal of wounded is that of the Elector, who carried off 7,000. They were deposited *en route* in a dying condition at the various villages, most being left at Ulm, which was a garrison, and subsequently besieged. The Elector's retreat lay through Dillingen, and this spot would in a similar contest to-day be the site of a clearing hospital, bearing in mind the fact that the Commander-in-chief of the French did not expect to be attacked, and would have brought up his line of communication units to places convenient for the advance. Having got a large clearing hospital there at Dillingen in the event of a rout such as Blenheim, it would have to remain, and receive the worst cases of the 7,000 which would be protected by

the Geneva Cross. As the retreat continued field ambulance after field ambulance would have to be demobilized at the villages passed through to take charge of those unfit to be carried further, unless the Elector had established hospitals at posts during his advance. And I hope no D.D.M.S. to-day would locate his immobilized field ambulance in a fortress like Ulm, which was bound to be invested by the pursuing foe.

The above represents the flight of a modern foe in our own country. In a country friendly to himself the local Red Cross organizations working as above through the I.G.C. would take over the wounded from the field ambulances and other means of transport as they passed through Lavingen, Gansburg, and other inhabited spots, at any rate with greater alacrity than they would the wounded of an invader.

To-day we have an organization such as was not dreamt of in 1704, and consequently much suffering may be avoided in a retreat, even though it be desirable to disguise the number of our wounded from an enemy. When a retreat becomes a flight concealment is out of the question, and we must sacrifice our tented portions in such positions and quantities as may be essential for the welfare of the wounded. It may be quite possible to disguise the number of wounded in an ordinary retirement, but not so in a debacle.

Both the Japanese and the Russians became adepts at this after some experience. The Japanese in the earlier phases found their organization required to be supplemented, as they did not provide the means for evacuation, at least up to the Battle of Liao-Yang. It must be borne in mind also that their system involved divided control of the machinery, and divided control has always led to inefficiency. Their field hospitals did not get near enough to the scene of action. The bearer battalions carried the wounded from the unit dressing stations to their own dressing stations, and from there to the field hospitals, some five miles to the rear. The latter had no ambulance transport. The result may be readily appreciated; the bearers were unequal to this very severe task, and transport from the dressing station to the field hospital had to be improvised. Further, they had to push up the field hospital to within two miles of the fighting line and sometimes within nearly a mile, a position similarly adopted by us upon occasion in South Africa, owing to scarcity of ambulance transport.

As the result of this lack of transport the Japanese field hospitals became overloaded, up to four times their receiving capacity

of 200. Again, the stationary hospital possessed no ambulance transport, so they had to be brought up close—as near as four miles—to the field hospital, and ambulance transport was extemporized by means of Chinese coolies and country carts. There was no question of retreat, so this improvised transport worked satisfactorily. In South Africa, except in Natal, there were no such means of improvisation. The Japanese, with their practical instincts, have now rectified this defect of transport behind the first line.

Now when one realizes that 80 per cent of the wounded require more or less prolonged treatment and have to be carried down the line, it is possible to form some idea of the congestion which occurred at the front and how such congestion must have tended to immobilize the force. During this Manchurian Campaign the Geneva Convention was observed; under such conditions, the defeated army need have no apprehension as to the fate of its wounded. But an army engaged with a savage foe would have to stand or fall beside the wounded in the event of a reverse. Such a contingency as necessitated bringing the line of communication units within a few miles of the action would entail the gravest consequences on a force which had to retreat before a savage enemy. These units should, therefore, be provided with an establishment of technical transport which should go to the front, to evacuate from the field hospital. In such a scheme the casualties are already moving rearwards.

In the Bohemian Campaign of 1866 the German Field Medical units were organized on much the same principle as our field ambulance of to-day; that is to say, they possessed a so-called flying detachment, the analogue of our bearer division, and a depot which fulfilled the rôle of our tent division—the whole reminiscent of the organization instituted by Baron Larrey more than half a century earlier. The stretcher-bearers were attached to the flying detachment. This system worked well, as far as the numbers permitted. That their numbers were inadequate to the work in hand may be realized from the fact that there were only 1,900 stretcher-bearers to the whole of the Prussian armies, consisting of 270,000 men. They were, however, assisted by the wheeled stretchers, with which we became familiar in South Africa, and the use of which by our bearer squads might be considered in view of the economy in personnel which should result, especially in connection with clearing hospitals. When, in the space of six weeks, "4,450 sons of the Fatherland (I quote from the German

official account) had bought the victory at the cost of their lives, 6,427 had fallen victims to cholera or other diseases, and 16,177 bore honourable wounds," it is not surprising that the stretcher-bearers took several days to clear the battlefield of Königgratz, and the light field hospitals in front and the scanty heavy field hospitals in the rear were insufficient for the wounded and sick, who found their way into the nearest cottages, houses, and public buildings, in twenty-eight different villages near.[1]

Behind the Army Medical Establishments there followed a number of civil organizations, the outcome of "a spontaneous effort of patriotism." These in the course of time became able to cope with the enormous numbers of wounded, some 30,000, including the Austrians left by their own people, and with the cholera which broke out in the neighbourhood of Prerau and Prosnitz on July 9, and subsequently became prevalent. Among these organizations that of the Knights of St. John of Jerusalem stands out, for, under Count Stohlberg, it was able to assist the overworked stretcher-bearers on the field of Königgratz. This campaign shows us the immense value of voluntary aid.

The Prussian Field Medical Establishments, then, were insufficient. They were unable to remove the wounded from the battlefield on to the line of communication. They had to fall back upon voluntary aid for the collection and treatment of the sick and wounded; and the voluntary aid was inadequate in the early phases of this short war. Further, sanitation, as we understand it, was absent, and the result of this was cholera. The German official historian writes: "It was proved here also that the fearful sufferings which war inflicts can only be insufficiently alleviated, and that no human arrangements can fully provide for the wants of an army immediately after a great battle." But the nation was not satisfied with this so-called proof, and the Prussians immediately after this war increased their mobile field medical units as the result of their latest experience. They realized that if the Austrian resistance had not been overcome rapidly, their sick and wounded would have been a formidable encumbrance to further operations.

During this war the Austrians left their wounded who had to be provided for in the over-filled hospitals extemporized by the Prussians. The Japanese sometimes had to take over Russian wounded, but that was by accident of the tactical position rather

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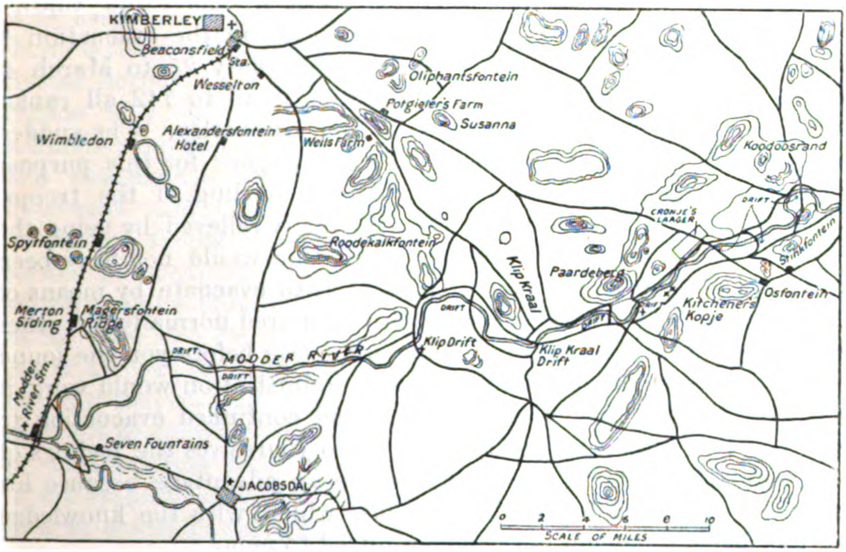
[1] Anyone who wishes details of the terrible condition of the wounded therein may find it in A.M.D. reports, 1865, p. 380.

than by design on the part of the Russians, for both sides did their best to disguise their losses. But the result was embarrassing to the victors, and it is more than likely that advantage may be taken of this in certain positions with the intention of impeding the mobility of an advancing foe. Such action is to be deprecated, and it is necessary to provide for the prompt removal of badly wounded, and to effect this the foremost medical units should be mainly carrying units; at the same time those in rear must have a sufficiency of transport to enable them to maintain the stream of evacuation from the front, assisted by such returning supply wagons and animals as may in some favourable circumstances become available.



Country between Paardeberg and Kimberley.
+ Field and Rest Hospitals.

The importance of this is emphasized in the following quotations from the "Official History of the War in South Africa" (vol. ii, p. 153), wherein the historian, discussing the advisability of pressing the attack upon Paardeberg after the fighting of February 18, 1900, observes:—

"Lord Roberts was met by the difficulty of dealing with the men wounded in the fighting on the 16th and 18th. These now filled the field hospitals to overflowing. If he assaulted Cronjé's

entrenchments before the sick and wounded had been sent off to the railway, the casualties . . . would overwhelm the surgeons and wholly disorganize the medical service. It was, therefore, essential to evacuate the field hospitals before the next general engagement took place; but to do this rapidly was out of the question, because, in order to supply adequate transport for the relief of Kimberley, the vehicles allotted to the Royal Army Medical Corps had been considerably reduced. . . . Whether Lord Roberts stormed the laager or reduced it by sap, bombardment, and starvation, he would be equally obliged to remain some days near Paardeberg, until he had sent off his wounded and renewed his stock of provisions from the railway."

And this state of things was still pressing on the Commander-in-chief up to March 4, when we read in the same volume (p. 182) that "Good progress had been made in the evacuation of the field hospitals. In the week from February 25 to March 4, convoys of sick and wounded, amounting in all to 742 all ranks, were removed to the Modder Camp and Kimberley. The sudden demand of the medical authorities for 100 wagons for this purpose withdrew transport badly needed for the feeding of the troops. Had the accumulation of sick been gradually relieved by using the empty wagons on their return journeys, this would not have been required." This shows how difficult it is to evacuate by means of Army Service Corps transport which is required normally for other purposes. But still, the official historian lays before you the sound principle on which the field medical administration would work if it possessed the means, viz., prompt and continued evacuation to the rear; he also leaves you to picture to yourselves the feelings of a Commander who is unable to pursue an advantage because his force has lost mobility through a cause which, with the knowledge at our disposal, should never be permitted to recur.

I trust the instances given have sufficiently illustrated my point with regard at least to an army in the field, that sick retained at the front immobilize the force and embarrass the Commander. It is impossible in the time at our disposal to enter into all the phases of war and the occasions related in history which bear upon the same principle. I cannot, however, close this paper without drawing attention to the condition produced in a garrison by the retention of sick. During the siege of Port Arthur the effective garrison was reduced from 60,000 to 24,000. Gunshot and disease had disposed of the remainder, and when the siege terminated the Russians had 16,000 men in hospital. In this

instance the sick and wounded had to be retained until the place surrendered. The fact that the Russian application to be allowed to send a hospital ship full of wounded out of the fort was not acceded to furnishes sufficient evidence that the Japanese recognized that the retention of the useless reduced the resisting power of the besieged. One cannot, therefore, when besieged rely upon meeting with the loftier humanitarianism of a Marlborough or a Roberts. And even when not besieged, in the case of a garrison within the radius of active operations, sick should never be retained. If railway communication does not admit of hospital trains removing the sick, they should be evacuated by road. Their retention in the vicinity of healthy troops is damaging to the general health, and depressing to the *moral* of those unaffected. And even when a state of war does not exist in the vicinity, the same holds good, as witness the concentration camps in the United States during the Cuban War. In civilized warfare there is no reason why sick should be retained in an unbesieged garrison wherein complete arrangements cannot be made for their isolation and treatment. Where such do not exist the sick should be evacuated, and if railway facilities do not permit of this the evacuation should be carried out by a staging system. The stages should be occupied by rest depots. And in civilized warfare these stages may be unguarded in most instances, unless the stages are being used also for military supplies. For an enemy will not go out of his way to capture a few wounded, an action neither glorious nor seriously damaging to his opponent. Constantinople at this moment promises to offer another lamentable example of the danger of accumulating wounded in a position which must be attacked in the event of success of the enemy, unless indeed the Turks are able to continue the movement with facility to Scutari or some more distant place across the Bosphorus. How much more useful would it have been had they possessed the necessary organization, to have removed at least the seriously wounded by lateral evacuation—as to Rodosto and thence by hospital ship—and so have eased the strategic line.

When the line of evacuation is an organized line of communication our experience now shows us it will be culpable to accumulate sick at the front, and in future the only plausible excuse for retaining them at the front will be that the force or garrison is cut off entirely from its communications, whether by design or by temporary accident, and is unable to create a special medical line of evacuation.

In the Manchurian War the Russian arrangements for evacuation became so admirable that the field army was not hampered with sick and wounded in spite of the enormous numbers of the latter. Ambulance trains, of which they possessed 113, seventeen of them operating in immediate rear of their armies, removed the wounded as fast as they were brought in from the field, in some instances approaching the scene of action so closely as to expose themselves to shell fire. And it was owing partly to the skilful evacuation of the wounded that General Kuropatkin was able to effect his remarkable retreat at Liao-Yang. Where railways are not available, the mobility of medical units should be so provided for that the movements of the Commander should never be hampered by such considerations as the care of his wounded. His field ambulances should clear the field in their front; the clearing hospital behind should send forward ambulance wagons or ambulance trollies to clear the field ambulance in front, and every stage down the line should send forward and clear the stage in front of it. Then if a retreat is necessary the movement of the wounded is already progressing to the rear, and will be assisted by all available supply vehicles. If a victory requires to be followed up, the Commander need not wait for the disposal of the wounded, for the field ambulance will be relieved of its wounded by the clearing hospital behind, and will be free to advance with the Commander ready for all eventualities, and the force will remain free of sick and wounded, and therefore healthy as well as mobile, so long as the sanitary requirements are duly attended to. Surely this condition will amply repay the cost of adding ambulance transport to the resources of the medical unit—clearing hospital, or whatever it be called—which is placed a stage behind the field force! For this is the only defect in our system. The value of such a measure is a matter of easy calculation—an equation. Facility for evacuation of sick gives the Commander a mobile force. No facility for evacuation of sick gives the Commander an immobile force. And the latter condition leads to a multiplication of difficulties, for it involves an increase of supplies to the front with a corresponding increase of Army Service Corps vehicles.

In our next war the Commander who encourages medical evacuation will be amply repaid by the condition of his troops, and will not need to sacrifice supplies to attain this object, as the extra Army Service Corps vehicles required to feed useless mouths will, in his case, be replaced by a small number of ambulance vehicles to effect evacuation.

I trust I have produced sufficient evidence from past history to show that : (1) A force *minus* sufficient medical transport produces immobility and larger Army Service Corps transport; and (2) a force *plus* sufficient medical transport produces mobility with a smaller Army Service Corps transport.

The necessary medical or ambulance transport must be a medical unit. In the stress of active war within sound of the guns, you cannot rely upon any other branch of the army to supply your needs, nor upon any improvised transport. Humanity to the wounded requires efficient evacuation; mobility of the army demands it.

This principle has been recognized in the German and Japanese armies, and also in the Indian.

The Germans now attach six motor ambulance wagons and six light motor lorries to their advanced depots of medical stores, so that they can be used for the transport of wounded from the field ambulances. And this is what we require for general mobilization, but preferably placed in the hands of the medical units at the head of the lines of communication. The units at the stages behind these may, perhaps, be able to improvise means of evacuation—practically certainly so in Europe.

The Indian Army headquarters contemplate a similar arrangement, for they have had tabulated for some years a unit happily designated an "Ambulance Column": and though up to March last this unit had not materialized, there is no doubt that in the event of war it would be included in their mobilization scheme, and would fulfil the function of evacuation from the front to the line of communication.

Time demands that I leave the question of facilities for evacuation of sick and wounded; it is not a new one, for Larrey with the French armies of the Revolution and of the Empire grasped it, and McGrigor carried it out in the Peninsula; but without giving further concrete examples, I trust that you will agree that a unit of ambulance transport is required to complete the chain of evacuation and thus deal promptly with the clearing of sick and wounded from the front, for this is the crux of the medical problem in the field.

And this is our rôle in war, one which justifies our existence among the field troops—the first line of the army; for there, while maintaining the health of the troops, we can be also of real use to the Commander at the time of urgent need; we can help him to retreat, or, better still, we can free him to advance.

DISCUSSION.

Colonel BEDFORD considered the recording of the names of sick and wounded a very important part of the duty of Voluntary Aid Detachments, but pointed out that no regulation on the subject was in existence. He himself had, while at the War Office, been instrumental in distributing copies of Army Book 27A (Admission and Discharge Book, Active Service) to these detachments for instructional purposes, and familiarity with this book should certainly be officially recognized as necessary for every Voluntary Aid Detachment.

Commenting on the evacuation of the wounded after Paardeberg, Colonel Bedford drew two lessons from that episode :—

(1) How deeply the medical situation may influence strategy and tactics; and (2) how surely any interference with our crystallized arrangements leads to ultimate difficulty in military movements.

Had our organization been left as arranged, there should have been no difficulty in disposing of casualties amounting to 8 per cent only of the force engaged. In future wars we may regard ourselves as very fortunate if we have only this comparatively small number to deal with. But in order to supplement his transport for the advance to Bloemfontein, Lord Roberts took away eight ambulance wagons from a total of ten apportioned to each bearer company, so that these units had only two wagons each. This naturally led to clogging, and illustrated the unwisdom of interfering with our carefully thought-out organization.

Dr. SANDWITH, speaking as Chairman of the County of London Branch of the Red Cross Society, attributed to Sir Alfred Keogh the fact that this organization is alive and spreading in England. There are 45,500 persons enrolled in the Red Cross Society, and 9,000 belonging to the Order of St. John, all very keen, all intelligent and capable of becoming very efficient, all anxious to receive recognition and to be *used*. There would be no difficulty in training them to keep registers of sick and wounded. All they want is to be asked to do more, and to be encouraged to believe themselves an important part of the machinery of the Medical Services in home defence. Possibly owing to the fact that there is such a preponderance of women in the Red Cross personnel this recognition and encouragement has not yet been given in full measure by the authorities at the War Office. In addition to the functions suggested by Colonel Skinner, the Red Cross detachments, if trained on wider lines, could assist effectually in bettering the sanitary conditions in localities where troops were operating, by improving the water supply, assisting in the isolation of cases, &c. Dr. Sandwith expressed satisfaction as well as a certain amount of surprise at finding that distinguished officers of the Army Medical Service really counted on the help of Voluntary Aid Detachments as supplementary to the fixed medical establishments of the Army, and he thought that this fact—though not yet endorsed by

much official recognition—could not fail to be encouraging to the members of the Red Cross Society.

Surgeon-General Babtie, bringing back the discussion to Colonel Skinner's paper, reminded the audience that the main contention was for a *link* between the front and the line of communication. Such a link exists in the clearing hospital—better called a clearing unit. In actual practice it was probable that this unit would fulfil a double rôle, one part being used exclusively for evacuation and another for purposes more allied to the functions of a stationary hospital. As for transport, we were *all* struggling for transport; but the General Staff was doing its best for the Army as a whole, and was thoroughly alive to the importance of the early and speedy evacuation of the wounded. Our advances as a Corps were the result of the fact that we had convinced the General Staff of our utility, and our value, thoroughly realized, would not be sacrificed for the sake of extra transport. Transport would come, though perhaps not exactly in the form that we should choose. One thing was certain, any transport that we might get would bear but a small proportion to the number of wounded. The clearing of a modern battlefield would be a problem *beyond* any pre-arranged organization, and would demand the highest efforts of all the agencies that might come into play.

Major Waggett hoped that Colonel Skinner's paper would be made available to a wider audience than the Society. Red Cross civilians should hear in an authoritative manner that their services were looked to by the Army Medical Service. The Red Cross personnel hardly realized that they were so highly valued or that they were really counted on for such important functions in war. It was time that they did so, and the lecture might well have a wider circulation than within the Corps only.

Lieutenant-Colonel Burtchaell wished for further information as to how the Elector of Bavaria managed to carry off his 7,000 wounded after the Battle of Blenheim. In view of our difficulties after Paardeberg, it must be regarded as a very notable performance, and it even involved the raising of the question of the accuracy of the historical records pertaining to the event. Returning to the question of the evacuation after Paardeberg, Lieutenant-Colonel Burtchaell expressed the opinion that this operation was, on the whole, very well carried out. To his own knowledge, 1,400 wounded, the casualties in the fight on the Sunday, had reached Klip Drift by Wednesday, whence they were sent in by ox wagon to Modder River. Only the wounded unfit to be moved were left on the ground. The men in the ox carts arrived in just as good condition as the men in the ambulance wagons; and, further, accepting the theory that mobile medical units should not part with their ambulance wagons, these could not have been used for evacuation had they been present with the bearer companies. As to the quotation from the "History of the War," there was a large body of opinion that the alleged "clogging" was not actually regarded by the Commander as a reason against attacking.

Colonel SKINNER, in reply, said that having been present at Paardeberg himself, his view of the situation was not quite that of Colonel Burtchaell. True, the wounded referred to *were* those of the first day's fighting, most of whom *were* removed by the third day. There were, however, 750 others as well as sick, who were evacuated later, and not by Klip Drift, but by a line running from Paardeberg Drift, 24 miles at a stretch with no water. The journey of these people was very far from comfortable. It was astonishing that the greatly depleted medical transport effected so much, but the situation was one of great tension, and any great increase of wounded might have made it a disaster. As regards the Elector's performance it was not a fiction and was quite intelligible when one realized the large number of vehicles which accompanied Armies during that period.

Clinical and other Notes.

NOTES ON TWO CASES OF KALA-AZAR.

By Captain W. DAVIS.
Royal Army Medical Corps.

The following brief notes on two cases of kala-azar may be of interest, as the disease is, I believe, rare amongst British soldiers, and these cases are the first that have come under my charge.

Private A., 1st Middlesex Regiment, was admitted to the Station Hospital, Dinapore, on April 24, 1912, and remained there for fifty-four days. During this period he suffered from fever of the type of a mild attack of enteric or paratyphoid A. Blood films were negative to malaria, and blood cultures negative to *Bacillus typhosus* and *B. paratyphosus* A. His sputum was examined for tubercle bacilli, also with negative results.

The patient was diagnosed "Pyrexia of uncertain origin," and was transferred to the Enteric Convalescent Depot at Naini Tal, where he arrived on June 17, 1912.

Whilst at the depot a blood culture was made, but no organism was found; his fæces and urine were examined a number of times, always with a negative result.

On July 26, 1912, Private A. was transferred as a case of rheumatic fever, from the Enteric Convalescent Depot to the Station Hospital, Naini Tal, where he came under my charge.

His condition on admission was rather striking. He was extremely emaciated, with a protruding abdomen. His complexion was markedly sallow, with areas of pigmentation round his eyes, at the sides of the forehead, and about the mouth; this pigmentation was also very noticeable round the nipples, in the axillæ and groins. Heart: the first sound was somewhat muffled and indistinct, no bruit could be detected. Lungs: normal. Abdominal examination revealed an extremely enlarged spleen, the edge being palpable almost on a level with the umbilicus. Urine normal.

The patient had mild evening pyrexia for six days after admission, his temperature then fell to normal. The emaciation, pigmentation, anæmia, greatly enlarged spleen, absence of malarial history and parasite, and the station from which patient came, suggested to me that he might be suffering from kala-azar.

A differential blood count was made on July 29, 1912. Result:—

Polynuclears	35	per cent
Lymphocytes	29·5	,,
Large mononuclears	30	,,
Eosinophiles	2	,,
Transitional	3·5	,,
Total	100	,,

The total number of leucocytes per c.mm. was 1,680.

This blood count was decidedly suggestive, so the patient was put on calcium chloride for a few days, and a liver puncture was made on August 7, 1912. The slides were examined by Major Grattan, R.A.M.C., and the Leishman body clearly demonstrated. A special Invaliding Board was held on August 12, 1912, and Private A. was sent home by the next mail steamer.

The second case, Private S., of the same regiment, occupied the same barrack room at Dinapore. He went to Kailana (a hill station) on April 4, 1912, and was there admitted to hospital. He had continuous fever for fourteen days, the temperature reaching 104·6° F., during which time his blood was examined for malaria with a negative result; a blood culture was made and also a Widal's test, neither of which afforded any information.

The patient was transferred to the Enteric Convalescent Depot at Naini Tal, on July 6, 1912, as a case of "pyrexia of uncertain origin." Here his blood, fæces, and urine were examined with negative results.

On July 20, 1912, the patient reported sick at the depot, complaining of abdominal pain. Temperature 100° to 102° F.; pulse 126; abdominal rigidity was present.

On July 23, 1912, a rub was heard over the base of the left lung; he was diagnosed "diaphragmatic pleurisy," and treated by strapping and expectorants.

Transferred to the Station Hospital, Naini Tal, on July 27, 1912. Here the pyrexia continued, and the patient's spleen was found to be extremely enlarged. Kala-azar was suspected, and a differential blood count was made. Result :—

Polynuclears	30 per cent
Lymphocytes	40 ,,
Large mononuclears	26 ,,
Transitionals	4 ,,

Total count, 1,160 leucocytes per cubic millimetre.

The patient, after considerable hesitation, consented to have a liver puncture made; the Leishman bodies were present in this case also.

Private S. was brought before an Invaliding Board on August 30, 1912, and pronounced unfit for further service.

A CASE OF SYPHILIS SIMULATING LIVER ABSCESS.

THAT tertiary syphilis of the liver may closely simulate hepatic abscess has long been recognized, but the fact that I have met with two such cases within a year leads to the idea that the condition may possibly occur more frequently than is sometimes suspected.

Private G., 2nd Hampshire Regiment, was admitted to the medical

ward of the Military Hospital, Mauritius, on August 7, 1912, which appeared to be the fifth day of his disease. On admission his temperature was 104° F. and he complained of headache and of pain in the hepatic region: the onset had been gradual and there was no history of preceding diarrhœal disease. His liver was enlarged upwards to the extent of two interspaces, the lower margin of the organ being in its normal position. This enlargement appeared to be confined to the right lobe, and, as far as could be ascertained, was uniform. No other abnormalities could be discovered on clinical examination. Urine and blood cultures made in ordinary broth and in bile-salt broth proved negative, as did the examination of blood films. There was no leucocytosis on admission, and the urine was normal except for the presence of considerable amounts of urinary indigogens.

Throughout the course of the disease his respiration rate was increased by about 3 or 4 per minute; his pulse never rose above 106; the temperature was irregular, but usually ranged between 102° and 103° F. in the evening, and after the first few days there were marked morning remissions, the temperature touching normal on several occasions.

The case was diagnosed "inflammation of the liver," and ipecac. gr. xxx was administered twice daily, a quarter of this amount of tannic acid being added later. During the patient's first week in hospital his liver symptoms became more marked and a slight icteroid tinge appeared. At this stage diarrhœa occurred, the bowels being moved about five times a day, and much mucus passed; repeated microscopical examinations on a warm stage showed no parasites, cultures on lactose media were also negative, nor did the blood serum show any agglutinins for *B. coli*.

The red cells steadily decreased in number to 3,900,000 (the hospital is 2,000 ft. above sea level) and the hæmoglobin fell to 50 per cent; there was no leucocytosis, the average white count being 6,900, and for this reason, unfortunately, no differential enumeration was made during the acute stage.

Occasionally the symptoms showed some amelioration for a day or two, which induced a false hope that improvement had commenced, and encouraged continuance of the ipecac. treatment.

The absence of leucocytosis caused some misgiving, not as affecting the original diagnosis, but one fancied that the prognosis might improve if an artificial leucocytosis could be induced, on the principle of the old-fashioned turpentine abscess. To this end a vaccine was prepared by mixing together six different vaccines, which happened to be in use at the time and which had been made from various inflammatory cases—two staphylococci, two streptococci, a *B. coli* and a *B. acidi lactici*—40,000,000 organisms of this blunderbuss-like concoction were injected on two occasions at four days' interval; the injection caused a marked local reaction at the seat of inoculation and the temperature rose 1° higher than any reading recorded during the preceding three

weeks. Twenty-four hours after the second injection the white blood count had risen to over 20,000—whether *propter* or *post!*—but this increase was not sustained, and although G. stated that he felt much better no signs of improvement could be observed.

The commencement of profuse night sweats, the more hectic type of temperature, and the patient's wasting led to the presence of pus being suspected, and on September 10 aspiration of the liver was performed under general anæsthesia. While on the operating table a distinct bulging of the thoracic wall over the liver was clearly discernible for the first time. The right lobe was aspirated at three different levels and from each of these points the needle was inserted into the liver first directly inwards, then upwards, downwards, forwards and backwards, so that very little of the right lobe can have been unexplored. No pus was discovered, but nevertheless some benefit from the aspiration was expected. However, this hope was disappointed, for the liver remained unaltered in size and his general condition unimproved; indeed, two days subsequent to the operation he appeared considerably worse.

The possibility of tertiary syphilis was then considered, but no specific history could be obtained although the patient acknowledged frequent exposure to infection. However, he was put on anti-syphilitic treatment, and with most striking results. There was an almost immediate improvement in his condition, the temperature steadily fell, and in three days reached normal. In another three days the hepatic enlargement had disappeared; the red blood count and colour index rose rapidly, and the patient made a quick and uninterrupted recovery. In the meantime a Wassermann's test had been carried out and the occurrence of a positive reaction resulted in the hypothetical diagnosis becoming a certainty.

A perusal of the medical history sheet shows that in 1911, before coming to Mauritius, G. was detained in hospital for over six months and underwent several operations for "Abscess C.T."; the after-knowledge of the case leads to the suspicion that this very resistant condition may also have been syphilitic in nature.

REPORT ON FOUR HUNDRED OPERATIONS UNDER SPINAL ANALGESIA AT THE CAMBRIDGE HOSPITAL, ALDERSHOT.

By Major J. W. H. HOUGHTON.
Royal Army Medical Corps.

Since the introduction of spinal analgesia into this country, following the publication of Mr. A. E. Barker's paper in the *British Medical Journal*, March 23, 1907, the use of this method for the induction of anæsthesia has rapidly extended. The method was first adopted in the Army by Major Spencer in 1907, and a report of our first fifty cases can be found

in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, November, 1907. There appears, however, to be still some diversity of opinion amongst surgeons as to the drug most suitable for this purpose, as well as some doubt as to the range of applicability of the method.

It may be useful, therefore, after five years' experience of this method, to record the following table of cases where the drug used has been the same in every case, and in which almost all were injected by the same operator using the same technique.

The choice of a drug for injection into the lumbar sac has gradually been narrowed to one of three substances, namely, stovain, tropacocain, and novocain.

Having reported previously in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, August, 1908, and October, 1909, my experiences with these drugs, it is only necessary to repeat here that the 5 per cent solution of stovain and glucose, as formulated by Mr. Barker, has given the most consistent and reliable results. This conclusion is well borne out by the results of these 400 cases, in all of which this solution was used during the past two years in the Cambridge Hospital, Aldershot.

SUMMARY OF OPERATIONS.

Herniotomy	111
Appendicitis (acute)	44
Appendicectomy (*à froid*)	44
Gastro-enterostomy	2
Intestinal anastomosis	2
Other laparotomies	7
Operations on kidney	1
Resection of ribs for empyæma	1
Total abdominal operations	212
Piles (Whitehead) and fistulæ	45
Pubis and genitalia	65
Reducing dislocation of hip	1
Amputations: Thigh, leg, foot	3
Wiring fractured patellæ	5
Internal semilunar cartilage and knee	20
Other operations on lower limbs	49
Failures to enter dural sac	Nil
,, induce analgesia	Nil
Total	188
Total abdominal and non-abdominal operations	400

There are one or two points in this table which call for remark :—

There was in this series no case of failure to enter and inject the spinal sac.

There was no case where injection was not followed by adequate analgesia.

There was no case which gave cause for any anxiety as to the safety of the method.

The patients were mostly young soldiers, and I had the advantage of three years' previous experience with this procedure, both in the Queen Alexandra Military Hospital in London and in Africa.

There were only two cases in this series where a general anæsthetic was employed to supplement the spinal injection. The first was a patient very debilitated by tuberculosis, whose femur was amputated for a tuberculous knee. This man was given chloroform before entering the operating theatre, as he was in too great pain to be moved otherwise. While under the general anæsthetic 5 cg. of stovain were injected into his lumbar sac for the purpose of minimising the shock of the amputation. The influence of stovain in diminishing shock has so recently been reported on by the Arris and Gale Lecturers, *British Medical Journal*, April 27, 1912, that it is only necessary to state here that my clinical experience leaves me in complete agreement with their findings.

The other man who was given chloroform was a case in which a ruptured appendix was suspected. He was given 5 cg. of stovain and the abdomen opened; a perforated duodenal ulcer and peritonitis was found, and the ensuing operation of gastro-jejunostomy, which occupied one hundred minutes, was completed under chloroform.

There is another advantage of this stovain-glucose solution, which apparently has not been fully realized. Although doubts have been expressed by workers in this field, as to the extent and duration of the analgesia which may be expected after a given injection, there is no doubt that these can be estimated beforehand with comparative certainty by the use of an injection compound of a higher specific gravity than that of the spinal fluid.

The solution, containing 5 per cent stovain and 5 per cent glucose, is heavier than the cerebrospinal fluid, it has a specific gravity 1·023, and the specific gravity of cerebrospinal fluid is 1·007. Thus, by elevating the pelvis of the patient before injection, the solution can be localized to any given segment of the spinal cord, as the solution will flow to the most dependent part of the spinal canal, and the extent of the analgesia can thus be determined before any injection is given.

As regards the duration of the analgesia, I have found that, with trifling variations, an injection of 0·9 c.c. of this solution, which contains 4½ cg. of stovain, maintains analgesia to the level of the umbilicus for forty-five minutes. This gives ample time for operations on hernia and appendicitis.

The amount of this solution that may be used can be increased, and in one case in this series the injection of 1·2 c.c., or 6 cg. of stovain was ample for the performance of the operation of gastro-jejunostomy. This was a severe test of the method, and its success a striking demonstration of its potentialities, as complete analgesia was maintained at the level of the xiphisternum for the forty minutes required to complete the operation.

As regards the after-effects of injection, in these series they were fairly constant.

In 24 per cent of the cases when the analgesia extended above the umbilicus, slight faintness or nausea came on from ten to fifteen minutes after the injection. This passed off in ten minutes, when the patients became drowsy and comfortable.

On returning to the ward, 7 per cent of the patients vomited; amongst these were several cases of abdominal trouble, which had been vomiting before operation.

Headache was reported in 40 per cent of the cases. It was usually mild and seldom interfered with the patients' sleep.

In 35 per cent of the cases injected there was no discomfort of any kind, either during or after operation, and, in the words of the theatre attendant, "they did not turn a hair."

Whether spinal analgesia or some form of inhalation anæsthesia is preferable for routine use is a question for the decision of the individual surgeon. In the hands of a careful administrator, and in cases where analgesia is neither required nor obtained above the nipple line, the use of this stovain-glucose solution is at least as safe as that of chloroform. Its field of usefulness is therefore restricted when compared with inhalation anæsthesia. On the other hand, life-saving operations can be performed under spinal analgesia in cases where chloroform or ether are inadmissible, such as amputation of the leg for gangrene in a patient with advanced cardiac disease. With stovain analgesia there is an absence of shock during operation, which is not obtained under inhalation or any other form of anæsthesia, and the muscular relaxation is so complete that much less time is required to complete an operation than if chloroform were used.

For those who can always command the services of a good anæsthetist, the choice of an anæsthetic is not a pressing matter, but for those who work abroad and have to operate short-handed, or perhaps even single-handed, a knowledge of spinal analgesia is a most valuable asset. To obtain the best results with this method the operator must have experience of the technique. It is among the first fifty or one hundred cases injected that incomplete analgesia or other troubles are likely to occur.

It is particularly suitable for routine work in the Army. The soldier is not only an excellent subject but prefers this method to chloroform.

The apparatus required is small and inexpensive. It will fit into a coat pocket.

On active service a knowledge of this method will more than repay the slight trouble involved in the mastery of its details. Under such conditions time is often very limited and assistants few. An anæsthetist may not be present. With a syringe costing 25s., and eightpence worth of stovain, two men can be surgically treated in less time than it takes the average chloroformist to render one patient insensible.

A PAINLESS METHOD OF PERFORMING CIRCUMCISION UNDER LOCAL ANALGESIA.

By Major F. J. W. PORTER, D.S.O.
Royal Army Medical Corps.

For many years past I have never performed this operation under anything but local analgesia—but I could never rely on the tissues near the frænum always being anæsthetic.

Some time ago I hit upon the plan of injecting the fluid in a circle around the root of the organ and massaging it right up to the præputial orifice. My precedure is as follows: The dorsal vessels are picked up and the needle passed under them. By rotating the soft parts to reach the point of the needle, half the circumference can be injected through this puncture, and by partly withdrawing the needle and pushing it in the opposite direction, the circle can be completed. About 15 or 20 c.c. of novocain solution is necessary, and analgesia is complete in about ten minutes. The single initial puncture is absolutely all that need be felt.

This method is probably not original, but as it was new to several officers in this station, and as it is still customary with some to use general anæsthesia for this trivial operation, I feel induced to send this communication to the Corps' Journal.

REPORT ON WATER PURIFICATION BY CHLORIDE OF LIME AT BIR-ID-DEHIB CAMP, MALTA.

By Major A. H. MORRIS.
Royal Army Medical Corps.

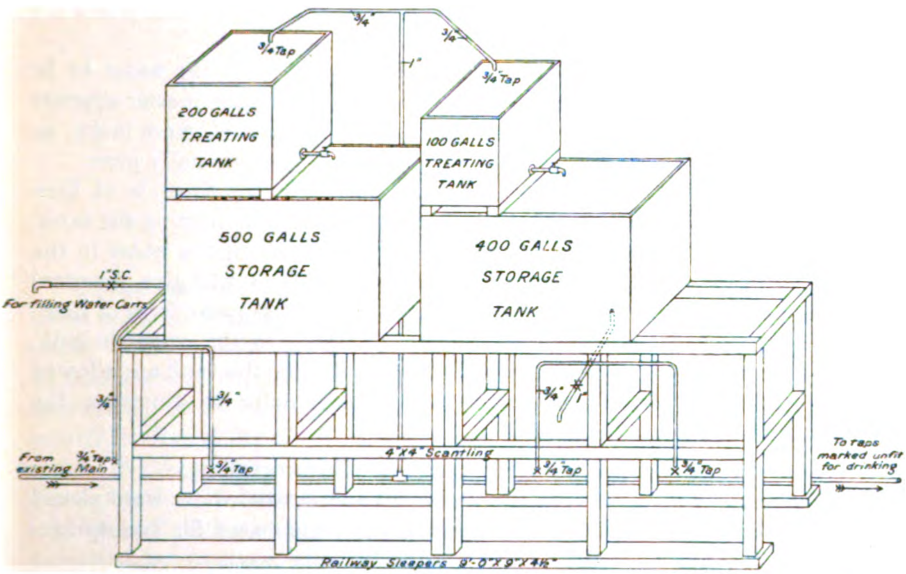
Having had considerable experience during the past months in treating drinking-water in large quantities with chloride of lime, I asked permission to make a trial of this method at Bir-id-Dehib camp during mobilization. Permission being given it was arranged with the Royal Engineers to instal the tanks necessary for the experiment. From the sketch it will be seen that the tanks were arranged in two series. Each series consisting of a small and a large tank.

The water was treated in the former, and when this was full it was allowed to flow into the latter where it rested, and was stored for use. The water was drawn directly from the large tank by means of taps either into water-bottles or water-carts.

The method of treatment was as follows: The chloride of lime was tested and found to give 17·5 per cent of available chlorine. A one per cent solution of chloride of lime was made by dissolving 1 grm. in 100 c.c. of water; this solution was made fresh and kept in the dark. One c.c. of this solution in 2 gallons of water approximately equals one

part per million of chloride of lime, for one million cubic centimetres equal 222 gallons.

To treat the 100 gallon tank (in the first series) 50 c.c. of this 1 per cent solution were taken and placed in a glass jar fitted with a tube and thumb-screw. The jar was then filled with water and the screw so adjusted that the solution flowed out in twenty minutes, which was just the time taken to fill the 100 gallon tank with water. This adjustment of the screw had been previously arrived at by experiment. The jar was placed on the top of the 100 gallon tank and the solution allowed to flow into the tank with the stream of water entering it. By this means the solution of chloride of lime was intimately mingled with the water



Sketch showing arrangements of Tanks for chemically treating water for drinking in the Mobilization Camp. Bir-id-Dehib, 1912.

entering the tank. When the tank was full of water, all the solution from the jar had flowed into it and it therefore contained one part per million chloride of lime or 0·175 parts per million available chlorine. The flow of water into the small tank was then stopped and the tap connecting the two tanks opened, when the contents of the small tank entered the large one. This process was repeated until the large one was full.

The procedure for the second series of tanks was similar, only 100 c.c. of the 1 per cent solution being used, as this tank was of 200 gallons capacity, and the solution was made to flow into the tank in forty minutes.

There was at first a faint taste and smell of chlorine in the treated

water, but in an hour this had quite disappeared and could not again be detected. The water was cool and palatable, and the results of the bacteriological analysis show that it was practically free from any intestinal organisms.

Remarks.—Where this method of treatment is successful its advantages over boiling are very great. It produces a cool, palatable water in a short time with little labour and, except for the installation of tanks, at infinitesimal cost. Moreover, the method is exceedingly simple and easily carried out by one man.

In the experiment at Bir-id-dehib, Captain P. S. Stewart, R.A.M.C., carried out all the details of treatment for two days with the greatest ease. The real crux of the method is to use only such a small amount of chloride of lime that the slight taste and smell at first given to the water are quickly removed.

To be able to do this it seems to me essential that the water to be treated must contain very little organic matter, as organic matter appears to take up the available chlorine. In this experiment we were lucky, as the water treated was the Farwara supply, which is organically pure.

Further, it is of the utmost importance to put in the chloride of lime in solution and to add the solution slowly to the water entering the tank. This insures an intimate mixture of the solution with all the water in the tank, and a much smaller quantity of chloride of lime will give practical sterility to a water, while the taste and smell will disappear from it more quickly than if the crude chloride of lime is added to the water in bulk. It is better still if the solution and the water entering the tank are allowed to drop from a height, as æration undoubtedly helps to eliminate the taste and smell from the water.

RESULTS OF BACTERIOLOGICAL EXAMINATIONS.

Various quantities of both the untreated and treated water were placed in MacConkey's bile salt lactose medium, and incubated for twenty-four hours at 37° C.

Results :—

(1) May 7. Untreated Water.

1 tube, 50 c.c.	Acid and gas	Lactose fermenters present in 10 c.c.
1 ,, 10 ,, ...	,, ,,	
1 ,, 10 ,, ...	No change	
5 tubes, 5 ,, ...	Acid and gas	
1 tube, 5 ,, ...	No change	

(2) May 8. Untreated water.

1 tube, 50 c.c.	Acid and gas	Lactose fermenters present in 10 c.c.
2 tubes, 10 ,, ...	,, ,,	
4 ,, 5 ,, ...	,, ,,	
2 ,, 5 ,, ...	No change	

(3) Water in tanks after treatment for 1 hour.

1 tube, 50 c.c.	No change	Lactose fermenters absent in 100 c.c.
3 tubes, 10 ,, ...	,,	
4 ,, 5 ,, ...	,,	

(4) Water in tanks after treatment for 4 hours.

1 tube, 50 c.c.	Acid and gas	Lactose fermenters present in 150 c.c. and absent in 100 c.c.
1 ,, 50 ,, ...	No change	
2 tubes, 10 ,, ...	,,	
6 ,, 5 ,, ...	,,	

(5) Untreated water, May 9.

1 tube, 10 c.c.	Acid and gas	Lactose fermenters present in 10 c.c.
1 ,, 10 ,, ...	No change	
5 tubes, 5 ,, ...	Acid and gas	
1 tube, 5 ,, ...	No change	

(6) Water in tanks after treatment for 24 hours.

2 tubes, 50 c.c.	No change	Lactose fermenters absent in 200 c.c.
4 ,, 10 ,, ...	,,	
12 ,, 5 ,, ...	,,	

(7) Water in tanks after treatment for 1 hour.

1 tube, 50 c.c.	No change	Lactose fermenters absent in 100 c.c.
2 tubes, 10 ,, ...	,,	
6 ,, 5 ,, ...	,,	

THE CURE OF TUBERCLE.

By Lieutenant-Colonel C. BIRT.
Royal Army Medical Corps.

Somewhat sensational articles have appeared recently in the daily press on a new cure for consumption. Thus it is stated in one newspaper:—"It should be clearly understood that Dr. Friedmann and the authorities who support him claim that they have an absolute specific against all forms of tuberculosis." In the *Berliner Klinische Wochenschrift* for November 18, 1912, there is a report of Friedmann's announcement to the Berlin Medical Association at their meeting held on November 6. He stated that he had treated 1,182 tubercular cases with injections of living cultures of a tubercle bacillus which he had rendered avirulent by passage, and by other means which he did not disclose. He first tested the preparation on himself, and found it harmless. For the treatment to be successful, a nodule, which remains for weeks, must form at the site of the inoculation. So long as the infiltration persists, the healing processes proceed. The remedy fails if an abscess forms at the spot. To obviate this he begins with an intravenous injection of the emulsion. He claims to have astonishing results. Bone and joint tubercular diseases heal in a few months; although they may have existed for years. Sinuses close and pulpy swellings subside. Relapses do not occur. Early tubercular lung affections recover. He stated that he had lost only six of 250 phthisical patients. The inoculations do not cause any local pulmonary reaction. Night sweats disappear and local and constitutional symptoms improve. Tubercular ulceration of the intestine is cured. He has administered prophylactic inoculations

to 335 new-born babies and infants, and has not noted any evil consequence. With such evidence before us, we are surprised to read that his animal experiments were not so convincing. The preparation is harmless to guinea-pigs, but it does not confer more than a low degree of immunity. The treated animals survived about 250 days longer than the untreated, after inoculation with a virulent tubercle growth, which killed the controls in 110 days.

In the discussion which followed, Müller related a case of advanced tubercular disease of the knee, in which six sinuses had been open for many months. Amputation appeared necessary. Nevertheless, after two injections in the autumn of 1911, the sinuses healed and the swelling subsided. He quoted other remarkable instances in which great benefit ensued. He watched the effects of prophylactic treatment of fifty-three infants in the year 1911. They were all healthy twelve months later.

Schleich was sceptical at first, but his opinion changed when he saw the good which was effected in tubercular diseases of the joints, bones, glands, and testes. He advocates the use of the remedy in every tubercular infection.

Karfunkel gave opportunities to Friedmann to treat 450 of his tubercular patients. He convinced himself of its harmlessness and its efficacy. In early pulmonary tuberculosis recovery ensues in two to four months. No bad effects were seen in 200 phthisical cases; 47 children recovered from scrofulous eczema in from ten to thirty days after receiving an injection; nineteen cases of chronic tubercular glands improved remarkably; the pain and swelling disappeared, and the sinuses closed. Twenty-two patients who were suffering from various eye affections were greatly benefited. Relapses did not occur. The success was remarkable in tubercular diseases of the joints and bones. The treatment was the means of saving limbs in several instances. Lupus underwent astonishing improvement under the influence of simultaneous intravenous and subcutaneous inoculations. He gave prophylactic injections to 45 children, among whom was his own son.

Kuster was impressed favourably with Friedmann's work, which he had been following for two years.

Heymann spoke with more constraint. His observations were confined to seventeen of his own patients, and to visits to Karfunkel's clinique. He saw there sixty patients who had been restored to health by means of the remedy. His own cases were farther advanced in the tubercular infection, and some were suffering from mixed infections; hence the benefit derived was not so striking, though improvement was marked in nearly all. He reported two recoveries from laryngeal tubercle.

Blasko was not very enthusiastic, and had seen no magic cures. His patients, however, had been treated before Friedmann had introduced his method of intravenous and intramuscular or subcutaneous injections.

Suppuration occurred at the site of inoculation. He saw marked improvement in an intractable case of tubercle of the finger. The patients whom he examined in Karfunkel's clinique had profited greatly by the remedy.

Citron deprecated the secrecy with which Friedmann shrouds the source of origin and the mode of preparation of the emulsion of tubercle bacilli. He stated that the tendency of recent investigations is towards the use of attenuated living cultures for the production of immunity; but he warned his hearers that cultures which are supposed to be avirulent are sometimes pathogenic. Pasteur's accidents with vaccines of the living fowl cholera bacillus, which he believed to be avirulent, should make us cautious. Citron conjectured that the remedy is a preparation of the tubercle bacillus of cold-blooded animals with which Friedmann experimented. He sympathized with Friedmann in his want of success in curing tubercular guinea-pigs.

Klemperer had no experience of this specific, but he had been occupied with similar researches for many years. In 1900, Koch stated that the human tubercle bacilli was not pathogenic to cattle. Behring next showed that inoculations with human cultures immunized these animals against bovine tubercle. Behring's observations were confirmed, and are now universally accepted. It was demonstrated twenty years ago by Klemperer in the pneumoccic infection of rabbits, and by Brieger, Kitasato, and Wassermann in hog cholera, that an inoculation with an attenuated living culture cuts short the infection if it is running a slow course. It may be laid down as a law that inoculation with the living attenuated micro-organism tends to arrest the progress of a chronic infective disease if the immunizing blow is of sufficient force. How can this be achieved in tuberculosis? Tuberculin is unavailing. By innumerable experiments on animals of every kind, it has been found that it is impossible to confer immunity against the tubercle bacillus by means of injections of tuberculin. The anti-bodies which are elaborated by it are not concerned in the protective processes. Klemperer moreover stated that tuberculin cannot cure tubercular animals. Since it is possible to save cattle from the effects of a lethal dose of bovine tubercle bacilli by frequently repeated and increasing injections of emulsions of living human tubercle, Klemperer tested the use of the bovine bacillus on man. During the last eight or nine years he has administered about a hundred injections of living bovine bacilli to people, including himself, without ill consequences. Unfortunately, these bovine tubercle inoculations exercised no beneficial effect on the human disease. In the years 1906 and 1907 Friedmann and he investigated cultures of a tubercle bacillus derived from the tortoise. This could not be employed as a vaccine since it caused suppuration when introduced beneath the skin. Friedmann's merit lies in the fact that he has overcome this difficulty. Behring ascertained that the bacillus inoculated must retain its vitality

in the tissues in order that the immunizing processes should proceed. The experience of veterinarians proves this. For the inoculation of cattle with human tubercle protects them from the bovine infection for six to twelve months only, that is, so long as the human bacilli remain alive. When they die, the immunity ceases.

At the adjourned discussion, Friedmann (*Berl. Klin. Woch.*, December 2, 1912, p. 2329), stated that his remedy did not consist of a tubercle bacillus of human origin which had been rendered avirulent. He had experimented with many cultures of this kind, but they were of no therapeutic value. In the years 1903 and 1904 he published observations on two cultures of tubercle which he had isolated from tortoises. They produced local lesions in guinea-pigs, in which the bacilli remained alive indefinitely. They were therefore unsuitable for therapeutic use. Bandelier and Röpke were unsuccessful in their attempts to benefit tuberculous patients with cultures of batrachian tubercle bacillus. Friedmann then said that he had isolated a third strain which is quite avirulent: it is absolutely harmless to guinea-pigs; animals which were inoculated with it two and three years ago are healthy in every way. He exhibited the infant child of phthisical parents, whom he had inoculated as a prophylactic precaution when seven weeks old, in October, 1911. The baby was well nourished and free from any ailment. The Pirquet reaction was negative.

Müller said that the recoveries he had seen after Friedmann's treatment could have been obtained by no other remedy; the cures of tubercular bone disease were remarkable.

Kausch warned his hearers against too great optimism, and reminded them of the extravagant hopes which were entertained when Koch introduced tuberculin, and that salvarsan was not the certain cure which was expected. Orth's animal experiments with the preparation were not in its favour. He himself had a large experience in the use of tuberculin. He claimed that with "tuberculin Rosenbach" he obtained results as successful as Friedmann's.

Piorskowski stated that in the year 1903, Friedmann asked him to give him laboratory facilities for the purpose of investigating the tubercular infection of a tortoise which had died in the Berlin Aquarium. The bacillus was isolated without great difficulty on glycerine serum and agar. Piorskowski then fed frogs and tortoises with tubercular sputum and succeeded in infecting two frogs and a tortoise. The cultures of the tubercle bacillus resembled Friedmann's original growth. Piorskowski therefore concluded that it was of human origin. He had no knowledge of Friedmann's third strain.

Aronson said that it is well known from many thousands of animal experiments that it is not possible to immunize against tubercle by means of tuberculin injections, except to a very slight extent. On the other hand, Levy, Marxer and Blumenthal conducted a series of careful

investigations some years ago, by which they showed that inoculations with killed tubercle bacilli protect guinea-pigs. Most of the animals lived longer than the controls, and some remained healthy: results which were as good as Friedmann's.

Wolff-Eisner thought that we should not be too dogmatic in pronouncing a culture to be avirulent. He had inoculated a guinea-pig with a strain of tubercle which did not cause death until eighteen months afterwards. Hence he looked upon Friedmann's prophylactic injections with some suspicion. His experience of vaccine therapy impressed him favourably.

Meyer spoke in favour of tuberculin injections in the treatment of tubercle. Heubner, Katzenstein, and he had published recoveries under it in surgical tuberculosis and in tubercular laryngitis. He asked Friedmann how long infants harbour these avirulent bacilli? Behring's attempts to immunize cattle by means of human tubercle appeared to be successful at first; but as soon as the human bacilli died out in the animals' bodies, they nearly all became tubercular. He referred to Orth's want of success in protecting guinea-pigs with Friedmann's culture, and quoted Ruppel's researches with "tuberculin serum vaccine" "(S.B.E.)" which were much more favourable.

Bier had seen many of Friedmann's cases, and though he believed a therapeutic influence was at work, he had discovered no absolute proof of it, since the majority was composed of such tubercular affections as recover under expectant treatment. He thought that we ought to know more about the preparation, and to experiment with it ourselves, before pronouncing an opinion on it; meanwhile he could not be brought forward as a witness in its favour.

Goldberg gave details of a case of early phthisis which appeared to be cured. He had used the remedy in twenty-one cases of tubercle of the lungs, and in one of tubercular eczema, with good effect in all.

Orth repeated what he said before; though the guinea-pigs inoculated with Friedmann's culture lived longer than the controls, yet they all succumbed when their immunity was tested by inoculating them with virulent tubercle bacilli.

Schwenk reported that Friedmann's treatment had had no curative effect on a woman who was suffering from tubercular ulceration of the bladder. Friedmann had described the case as cured.

Katzenstein believed that small doses of tuberculin were very valuable in the treatment of bone and joint tuberculosis. He could not understand how Friedmann's injections would benefit advanced pulmonary phthisis, since a mixed infection always then exists.

Friedmann in conclusion promised to publish the constitution and preparation of his remedy, and also to distribute it to the public as soon as possible.

PIGNET'S METHOD ADAPTED TO BRITISH STANDARDS.

By Captain J. A. BALCK.
Royal Army Medical Corps.

Some time ago I published a paper on the value of Pignet's factor as applied to British recruits. A great drawback of the method from our point of view, is of course that it only applies to measurements taken by the metric system. To be of general utility it must be translated into, or adapted to, British weights and measures. Mere translation, *i.e.*, substituting inches for centimetres, and pounds for kilogrammes, will however, not do. The ormula as it stands is:—

$$F = H - (W + C),$$

in which H represents the height in centimetres, W the weight in kilogrammes, and C the chest measurement at greatest expiration again in centimetres, with the result that the smaller F (*i.e.*, the difference between H and (W + C)) the better the man. Merely substituting English weights and measures would give us negative figures which are always unhandy.

It is obvious that some reconstruction becomes necessary. The form it should take is, I suggest, the following:—

$$F = (W + C) - H.$$

Of course in this form the greater the factor F the better the man. When making this change I have also made an alteration in the value of C. It now represents chest measurement at greatest inspiration, which is the one British recruiting standards always use.

In its new shape the scale corresponding to Pignet's runs as follows:—

Under 80	Useless.
80—90	Weak.
90—100	Fair.
100—110	Good.
110—120	Strong.
Over 120	Very strong.

I do not claim that the values obtained here are equivalent to those under the same heading in Pignet's scale, but for British recruits they represent a good working guide. Another figure of some importance is the one which a recruit should be expected to attain before being dismissed gymnasium. I have found eighty-five one which certainly does not err on the side of severity, and is, I think, the minimum to be expected after six months' training.

I am indebted to Colonel Sawyer, A.D.M.S., for the original suggestion of which this note gives the result, and to Major J. H. Brunskill, R.A.M.C., for his help in arriving at the formula finally selected.

Travel.

A MOTOR VENTURE IN CEYLON.

By Major F. A. SYMONS.
Royal Army Medical Corps.

A great deal has been written concerning the scenic beauty, the rubber plantations, the tea estates, and the wonderful commercial value of the little island of Ceylon; and all these things are undoubtedly of much interest. The traveller, however, during his usual short stay in the island, either fresh from Europe on his way to the Farther East, or replete with the beauties of Japan on his return journey homewards, is generally satisfied with what he can see by means of the train, or during a short motor journey to Trincomalee or Kandy. But to the student of history there are many things other than Nature's charms which may with advantage be explored, and incidentally he will also see the ordinary items of interest which usually suffice the more casual traveller.

In these modern days of motor cars the outlying districts are open to all. The roads are excellent, and the rest houses (the dàk bungalows of India) are provided with everything necessary for the comfort of even a European tourist. It is true that if the common barn-door fowl should become extinct the rest-house *menus* would diminish to almost vanishing point. The fowl in the East holds that exalted position which bacon-and-eggs commands in England. To exterminate either would mean national disaster. As the fowl, however, still remains indigenous to Ceylon all things are in readiness, at any time, for him who may care to loiter at the wayside caravanserai.

A motor tour such as has recently fallen to my lot, visiting as I did, firstly, the most ancient structures that Ceylon can produce, and later on, those relics of the comparatively modern history of the Portuguese and Dutch occupation, affords joys for the antiquary that any country might envy.

My geographical guide, a subaltern friend in a British regiment in Ceylon, offered to convey me in his motor car. He warned me of his own small knowledge of cars and his want of a qualified chauffeur. His Tamil boy, who had learned what he could during the previous few weeks, was reputed to be useful enough to take with us. It may as well be recorded, first as last, that this boy was worth the rest of us put together. In fact, considering the scarcity of his real knowledge of machinery, he must at times have been little short of inspired.

We started from Colombo along the western coast line. The driving is difficult there on account of numerous native bullock carts and two-wheeled ekkas, which refuse to make way until the last moment. Beyond smashing the shaft of one ekka, however, we came to no harm before luncheon. Passing Negombo, a couple of miles on our left, we rushed through miles of cocoanut palms and rice fields to Chilaw. Shortly after leaving the latter village one begins to catch glimpses of the great Puttalam lagoon, and 81 miles from Colombo the road runs abreast of this refreshing stretch of water and one finds oneself at Puttalam rest-house, where tiffin waits.

Forty-six miles remained to be covered before Anuradhapura could be reached. As the latter sacred ruined city was our goal, my host decided to push on early. We ran out into the jungle with light hearts, and all seemed well. But within eight miles we found that the water had boiled away! The country was as dry as a cinder. The engines were smoking and almost red hot as we pushed along through virgin forest. Beer was suggested for the radiator, but we prized our few beer bottles, and, in any case, doubted its efficacy. My resourceful friend at last assuaged the beast's thirst with cocoanut milk, but the quantity was insufficient. At last, at sunset, after we seemed to have burnt away half the cylinders, we sighted some chatties of water, placed by the charitable under the trees for the use of thirsty coolies. We did not hesitate. If money can avail a thirsty native no more need be said, for we left a coin in the empty vessel and fled once more into the fast gathering dusk.

After dark, country carts, lampless, loomed up with startling suddenness across our path. We dodged these miraculously. The moon rose above the tree tops. Still we pressed onwards, through country devoid of rest-houses and as forlorn as the heart of Africa. An animal or two crossed the road far ahead amidst the shadows. A bear or panther might at any moment be expected. Suddenly a couple of great water buffaloes gazed casually up the road in the moonlight. My steersman's accuracy was never his strong point. A buffalo failed to move at the critical moment. In another second the car ricochetted off the animal's rump, turned at right angles, and away we went, down a bank and across the sun-baked paddy fields, until a front tyre burst against a bunker.

We breathed a prayer of thankfulness for our lives, but said other things relative to buffaloes and all their kind. For the moment our beds at Anuradhapura seemed but vain imaginings.

To get the car back to the road appeared a hopeless task. The Tamil boy was here, however, at his best. With all his soul in his work, and a coolie to help him, he adjusted a Stepney wheel in the quickest time on record, and, together, we heaved and sweated at the wheels as the wretched car panted up the bank between us and the road.

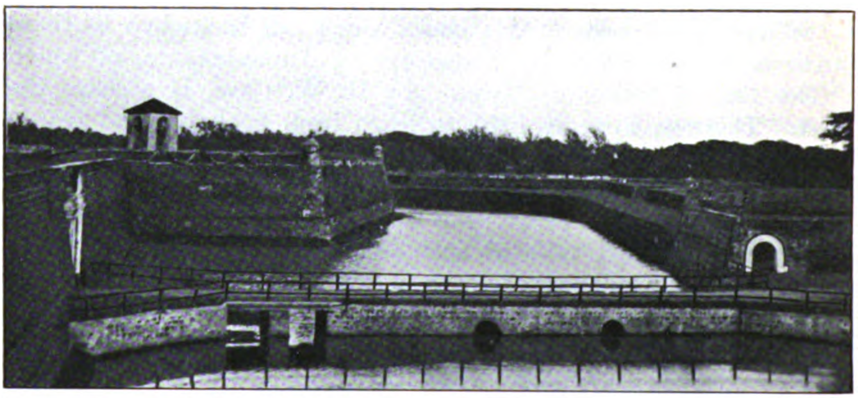
The exertions of the engines then fused two sparking plugs, but the Tamil correctly diagnosed difficulties and "tickled" the carburetter with such harlequin movements from his seat, that eventually he was rewarded by landing us, unhurt, at our destination. At midnight we raised the echoes of the sacred city, snorting in the moonlight past ghostly stone pillars which at once reminded one of Stonehenge, and awakening the rest-house with our calls for drink and food.

There are several reliable books which can be studied by those anxious for an exhaustive knowledge of Anuradhapura, of which "The Ruined Cities of Ceylon," by H. W. Cave, is perhaps the best. There is, however, little to learn from books beyond scanty history. To study thoroughly one of those structures which rise above the trees like some lost dome of a St. Paul's or St. Peter's, is to see them all. It is said that even India can produce no structural Buddhist relic of such ancient date as these. Each *dagaba*—as the bell-shaped mass of masonry is called—is several hundred feet in height, rising from a base covering anything up to 8 acres. The largest is said to be 50 ft. higher than St. Paul's Cathedral, with a diameter of 360 ft. A dagaba is constructed of nothing but a solid mass of bricks originally covered with cement. Its base is terraced for the purpose of supporting images of Buddha, &c. The sides of the terraces are covered with stone-carved animals, mostly elephants, but above the three or four lines of terraces the great dome rises up free from decoration. There is nothing inside a dagaba. The solid mass of brick is nothing but a blind offering to Buddha. Around the base of a dagaba there are several acres of stone pavement, forming a platform to which lead stone-carved steps from the jungle below. The carving of animals upon the balustrades of these approaches is remarkably good, resembling modern carving far more than those one is accustomed to find in other countries dating from 300 B.C., as these do.

The symmetry of these buildings, the architectural culture displayed in the general scheme of structure, and the beauty of the carved pillars found in the vicinity, which have formed parts of princely pavilions, cause one to pause in wonder. From whence came the knowledge of these things?

History relates that the son of King Asoka, who ruled practically the whole of India, was sent by his father to Ceylon to convert King Tissa of Ceylon about the year 310 B.C. Tissa seems to have been an easy convert. He at once ordered his followers to embrace Buddhism, and with his own hands ploughed with a golden plough the boundaries of the sacred city, for which he cut twenty square miles from his own pleasure park. But to embrace a new faith does not impart a knowledge of craftsmanship! The Indian missionaries must have done more than teach the tenets of the new religion.

Asoka also gave Tissa a branch of the fig tree beneath the shade of which Buddha studied. This was planted, amidst much cere-



The Fort and Moat at Jaffna.

mony, at Anuradhapura two thousand years ago. Surrounded by temple walls, it is still growing, and is called the sacred *bo-tree*. I was offered some of its leaves as souvenirs by the priest in charge.

About a mile out of Anuradhapura lies an interesting rock temple. One climbs a stone stairway and finds a little temple upon a great rock about thirty feet up. Two priests in their yellow robes, carrying huge keys, did the honours. A great brass-bound door was unlocked and we entered an antechamber, where lay offerings of flowers, a gramophone, and framed photographs. Amongst the latter was an autograph one of the German Crown Princess, presented to the old priest this year. Having shown his treasures and insisted upon singing an unintelligible chant, the old man opened the second door. An enormous image of Buddha, painted yellow,

loomed up in the dim light. At its feet reposed many smaller images, and a large tray, covered with silver rings, bangles, and money. The latter offerings, he explained, would eventually be melted down and fashioned into a silver Buddha.

To understand the elements of the Buddhist faith is no easy matter. The explanation seems to be that its followers themselves do not clearly know what they are asked to believe. I had been reading various books which seemed to me to be extraordinarily

A ruined Dagaba.

contradictory. By means of an interpreter, in the shape of a young English police officer, I opened out into questioning. The priests were quite ready to give their views, but not without certain deprecating shrugs and doubtful assurances. Plain answers to plain questions are in things spiritual notorious stumbling-blocks.

The ideas of the Buddhist faith which I had assimilated were as quoted in Cave's book. The transmigration of souls is clear

enough. To become obliterated would seem to be the hope of eventual bliss. To become so good that the soul enters a Buddha would seem to be the last stage before final extinction and rest. The original Buddha, therefore, should be dead long ago. My priestly instructor nevertheless did not admit this. He said that the spirit of Buddha was still in the heavens. There seems no doubt, however, that despite contrary opinions which I have heard, there is no supreme God which they worship.

The four broad dogmas of their belief would seem to be as quoted by Cave :—

(1) Existence is sorrow.

(2) Desire for existence is the cause of sorrow.

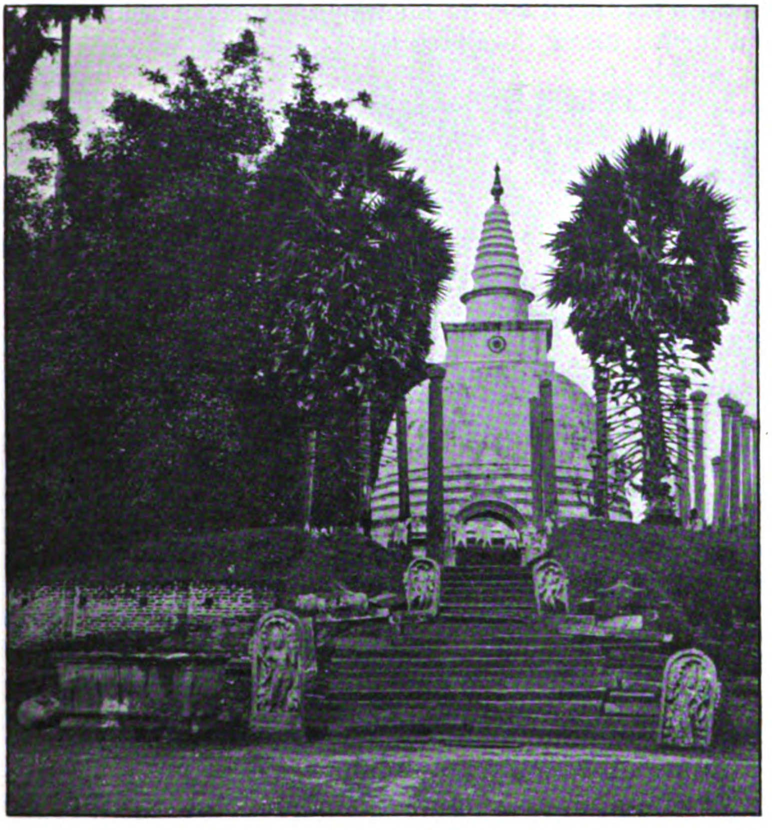
(3) The cessation of sorrow is effected by the eradication of desire.

Jaffna Fort from outside (old Dutch church in middle).

(4) The way of living which leads to the extinction of sorrow is the practice of right faith, right resolve, right speech, right action, right living, right recollectedness, and right meditation.

I asked the old man what *he* expected to be in his next existence. He did not know, but thought that he might be good enough to be another man instead of an animal. "Could you be an Englishman?" I asked. "Yes," was the answer, "or even a woman." But to be a woman would, he explained, be descending in the scale. As he had no god, what did he pray for I asked. He prayed against devils. The spirit of Buddha could help him in this.

The doubtful points concerning a clear understanding of this faith would seem to be accounted for by the various phases which the religion must have passed through since its invention by the first Buddha—Gotama—who opened his campaign in and about Benares in the sixth century B.C. The history of the various sects into which the Christian religion has unfortunately been



A Dagaba in comparative preservation.

divided affords quite sufficient parallel. No doubt also the ordinary wayside Buddhist priest is not highly educated, which would account for much incorrect word-of-mouth teaching.

The ruined condition of Anuradhapura is due to the raids of the Tamils, who for many years usurped the Cingalese throne.

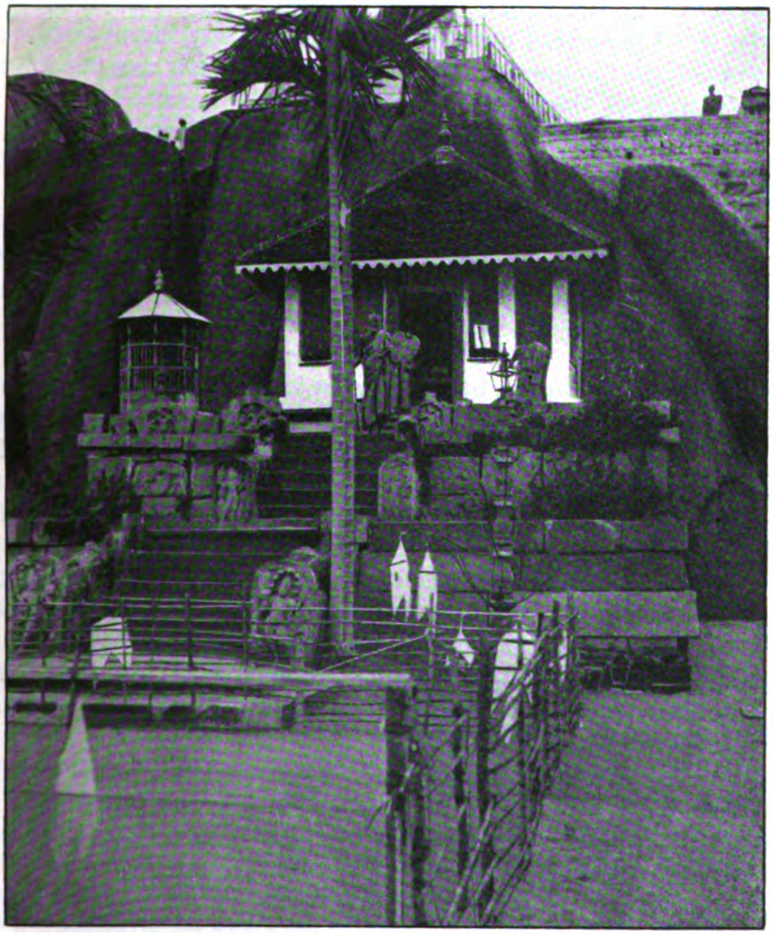
We spent several days at this interesting centre until our minds were steeped in relics. In the meanwhile a new tyre and new

sparking plugs had arrived by train. We also added our friend the police officer to our party. With renewed hope and our trials of the days before forgotten, the Tamil boy once more "tickled" the carburetter, my subaltern host took his seat, and we rushed forth once more to conquer or die. We had wired for tiffin to be ready at noon at a rest-house sixty miles along the road to Jaffna. Our police officer lived in the fort at Jaffna, and we were anxious to dine there that night and dream away the evening looking out upon the moonlit moat of the Dutch fort.

Remains of Dagaba, showing carved pillars of approaches, &c.

Man, however, can but propose. With my late host at the steering-wheel, it would be ridiculous to cultivate ideas of certainty! The car buzzed along with never a hitch. Virgin jungle and villages flew by at full speed. The steersman smiled happily. Tiffin was but ten miles off, and we counted the milestones. Suddenly four country carts appeared on the horizon. Their drivers sat beneath them, preparing their midday meal. A heap of stones intervened. In another incalculable period of time our mud guards were like depressed concertinas, and one of the back wheels fell like a house of cards with every spoke broken.

Speech was beyond us. The car was left in charge of the Tamil boy; the police officer quietly, but firmly, used his authority; a dozen frightened carters pushed the car into a ditch out of the main roadway, and, shouldering our boxes, preceded us, lunchless, worn, and sad along the dusty road. At length, after miles of



Rock Temple and Buddhist Priest.

walking in the heat of the noonday sun, we found the railway, and some hours later a train.

Crossing Elephant Pass in the cool of the evening we at last reached that ancient and renowned fortress of Jaffna. The moon-

light streamed across the lagoon, and touched with silver the ripples of the moat. Within the fort was to be found our dinner. I, for one, possessed a thirst which few people who have not visited the East have known. The great stone house of our host, at one time the residence of some officer of the Dutch garrison, welcomed us. The stone baths, large enough to swim in and fed from a deep cool well, awaited us. We had earned our refreshment, and we got it. I wondered upon what the Tamil boy, alone amidst the shadows of the jungle, meditated concerning motor cars and other kindred devils of the night.

The fort at Jaffna was built in 1680 after the fashion of Maurice of Nassau. Upon its site originally stood an old Portuguese fort which the Dutch besieged for a year and captured. The Portuguese defences have disappeared, but within the old Dutch church inside the fort are to be seen the memorial stones of certain Portuguese officers. These have been preserved from the old Portuguese church, which, like the fort, was replaced by the more modern Dutch structure.

The fort at present is in an excellent state of repair. Built in the form of a pentagon and surrounded by an extensive moat and outlying bastions, it encloses a space of about twelve acres. Far out in the lagoon lies a small fortification acting as a sentinel to the greater fort. The Dutch (it is reported) captured this small fort and so prevented the arrival of any reinforcements from Goa by sea. They then sat down about Jaffna and starved the Portuguese out. Within the fort there are several spacious stone houses built by the Dutch. That once occupied by the Commandant is now the dwelling used by high government officials when on tour. The police officer, the Civil Service representative, and various minor officials live within the walls also.

The Dutch church, dated 1706, is a handsome and spacious edifice. No services are held there now, but the organ loft, the Commandant's pew, the pulpit, and certain other pews, constructed of polished wood not common to the country, are very interesting. A Portuguese bronze bell occupies a vestibule, the sole remnant of the original Portuguese church of "Our Lady of Miracles." The memorial slabs in the pavement of the church and a few upon the walls record to some extent the history of the fort to the passing stranger. Here lie several commandants, officers in the Portuguese or Dutch army, the principal of which would appear to have been Baron de Reder. The British occupation, in the earlier half of the nineteenth century, comes into minor evidence in the shape of

records of the Ceylon Rifle Regiment. This regiment is no longer in existence.

There seem to be no legends of love and tragedy handed down, but one cannot wander about the silent ramparts and echoing corridors without wondering somewhat of the histories of those who have trodden the selfsame stones before. Trincomalee Fort has its story of a despairing maiden who sprang into the sea from the fort above the cliffs when she saw her lover sail away. Surely Jaffna must likewise have been the scene of more than one romantic history! And yet amidst the stone passages one sees no ghost of fair maiden nor hears the sighs of restless souls. The Dutch were ever a stolid race!

The native town of Jaffna, inhabited by some 45,000 Tamils and Moormen is much more akin to Southern India than Ceylon. It is laid out in parallel streets of native dwellings, each compound being neatly enclosed by fences of palmyra or cocoanut leaves. The beach, upon which the unloading of the fishing boats is a daily occurrence, is an excellent place for the zoological adventurer. The bag of one boat, seen by me the day after our arrival, consisted of three sharks, four devil fish (a variety of skate), six turtles, and a heap of smaller fry not unlike large perch. Turtle soup is cheap and plentiful at Jaffna.

There is a prison here also, where 217 native prisoners from various parts of Ceylon serve their terms. They are mostly murderers, but are fed well, and, as in all convict prisons, are not worked unduly hard.

The Dutch were apparently not left in peace at Jaffna, but were kept on the defensive by the Portuguese for some time after their occupation of the district. There are several smaller forts higher up the coast for twenty miles or so, but none of them are on the same footing as Jaffna with its original armament of 142 guns.

My subaltern friend captured a native carpenter, who may with truth describe himself in future as a motor builder. The broken wheel was excellently respoked. To return seventy miles by train and start motor life anew required a little courage. The Englishman may feel fear, but he must not show it. We started. What happened next, or what sights we saw, must remain, I fear, for the present untold. The world possesses many travellers. Some others, no doubt, will wish to speak.

Reviews.

TROPICAL MEDICINE AND HYGIENE. By C. W. Daniels. Part III. London: John Bale, Sons and Danielsson. Price 7s. 6d. net.

This third Part of Daniels' "Tropical Medicine" deals with diseases due to bacteria and other vegetable parasites, to dietetic errors and to unknown causes. The two earlier Parts have already been reviewed in this Journal and, in the main, the criticisms which were made about them apply to this volume. We get the impression that the book was compiled from notes made for lectures, added to from time to time, and that it is badly in need of rearranging. The absence of orderly arrangement has resulted in some curious omissions; we have already referred in former reviews to the inadequate description of liver abscess. In this volume, for example, the chapter on "Cholera" contains no mention of suppression of urine as one of the chief dangers; whilst the differential diagnosis of plague is omitted. Three pages are devoted to enteric fever; this is such a very important disease in the Tropics that one would have thought it worth while to deal with it thoroughly, if at all. The section on "Bacillary Dysentery" is better than most of them, and we were pleased to find the writer insisting on the fact that dysentery may occur without the passage of obvious blood or mucus at any time. The arrangement of the book according to causes of disease has resulted in divorcing the description of bacillary dysentery from that of amœbic dysentery, a considerable disadvantage in a book intended for the instruction of tropical practitioners. One extraordinary slip occurs on page 52, where it is stated that "it is sounder to prepare an anti-dysenteric serum (*sic*) from the organisms isolated from the patient's stool or blood." As the preparation of a horse takes several months, this seems a somewhat futile proceeding; possibly the author meant vaccine, but the context leads one to believe that he had serum in his mind.

In the section on "The Disposal of Excreta" we were sorry to see the abominable system of making "Poudrette" described without any words of condemnation. The dry-earth system in India slew thousands of soldiers in its time, and the "Poudrette" system is infinitely worse, since for a paltry profit to the town or station it secures the distribution of infective material over the whole neighbourhood.

The book is nicely got up, there is plenty of good matter in it, but it is very badly in need of editing. W. S. H.

BRITISH RED CROSS SOCIETY. First-aid Manual, No. 1. By Colonel James Cantlie, V.D., F.R.C.S., R.A.M.C. (T.F.). Cassell and Co., Limited, 1912. Pp. 210. Illustrations 120. Price 1s. net.

The author has compiled a series of three manuals, previously referred to in this Journal, as the official Manuals of the British Red Cross Society, issued with the approval of the War Office and primarily intended for the use of Voluntary Aid Detachments.

No. 1 covers the whole field of First-aid and is clear, concise, and well

illustrated. Apart from its suitability for any one taking up Red Cross work, it will form the recognized text-book on First-aid for Voluntary Aid Detachments. C. H.

MILITARY HYGIENE AND SANITATION. By Colonel C. H. Melville, R.A.M.C. Edward Arnold, 1912. Pp. vii. and 418. Price 12s. 6d. net.

The late Professor of Hygiene at the Royal Army Medical College has not attempted in this book to deal with the whole science of hygiene, limiting himself to those parts of it that are most important for the military officer, combatant or medical. He has thus given himself more space for dealing fully with certain questions that are either not dealt with at all in the ordinary manuals, or are only touched on superficially. The method of treatment is quite original, and is throughout calculated to arouse and maintain the reader's interest. Beginning with a consideration of the recruit, his condition and training, the author deals at length with the subjects of dieting, water supply, removal of waste matters, barracks, clothing and equipment, concluding with chapters on "Prevention of Disease and Disinfection." The discussion of these matters is fresh and vigorous, the note of personal experience is everywhere obvious: the writer draws on his own first-hand knowledge and abstains from the repetition of time-honoured (perhaps antiquated) formulæ.

It is clearly stated that sanitation is to be considered as a form of insurance; the amount of money to be spent on it is that sum which will effectually protect the soldier from physical inefficiency and disease; this principle is readily recognized in private life, on the large scale in regard to a great public Service the same considerations should hold good; the amount to be expended on the insurance is to be proportioned to the benefit that results. Some very sensible remarks are made in chapter II on "The Relations between Sanitary Officers (*i.e.*, Medical Officers), D.D.M.S.'s and Combatant Officers:—"The sanitary officer is a staff officer to the D.D.M.S. or A.D.M.S. as the case may be, and not to the Commander-in-Chief, or General Officer Commanding." The responsible adviser of the General is the D.D.M.S., he may delegate his sanitary powers largely to the sanitary officer, but he cannot delegate his sanitary responsibility. Moreover, "the executive sanitary officers of the British Army are the squadron, company and battery officers." This is not always realized by those officers themselves.

It is difficult to select one chapter more than another as of especial interest: each subject is dealt with in a fresh and original manner, with a personal note throughout. A useful distinction is drawn between "physical education," which is a matter of learning, and "physical training," that is, the practice of regular exercise to maintain "fitness." The now happily abandoned "breathing exercises" are criticized; they are still apparently in use in the French Army. Colonel Melville considers, in regard to water purification, that if it is necessary, it should be carried out under some central authority, and not by the individual consumer, or "under regimental arrangements." Everyone acquainted with the conditions that in practice attend so-called "purification" by comparatively unskilled, and (in regard to this matter) ignorant persons, will endorse this opinion. The author is not sparing of criticism when needful. The bandolier method of carrying ammunition, until

lately in use in our army, is stigmatized as the worst possible, from the physiological point of view, hampering every respiration, and greatly impeding evaporation from the chest. The proper method of carrying food and necessaries is carefully explained. It must be admitted that there are difficulties in the selection and suitable arrangement of the *sine quâ non* articles and perhaps finality has not yet been reached.

The prevention of infectious disease is considered under the three heads of (*a*) the source of infection, that is, the infected man; (*b*) the disease germ, which constitutes the infective agent; and (*c*) the non-infected man, who has to be protected. The different ways by which infection leaves (*a*) and enters (*c*) are detailed, and the various measures applicable to each case considered; the principles of prevention are thus made logically clear and practically intelligible.

Throughout the work there is evidence of the writer's wide experience. This, and the fresh and vigorous mode of expression, render the work more interesting and readable than scientific text-books are wont to be. Though primarily intended for the use of medical officers it will be found to be both interesting and profitable to officers of all branches of the military service.

ELEMENTS OF PRACTICAL MEDICINE. By A. H. Carter, M.D., M.Sc., &c., &c., Professor of Medicine, University of Birmingham. Publisher: H. K. Lewis, 136, Gower Street, London, W.C. Tenth Edition. Pp. xviii and 683.

The tenth edition of Dr. Carter's "Elements of Medicine" well maintains the reputation of its predecessors. The concise method of arrangement is followed, as in former editions, but the whole book has been carefully revised and much of the text has been re-written and modified. For reference, and especially for examination purposes, the book will, we think, be found valuable; as the information given under the various sections is precise, definite, and covers all the main points concerned.

The sections on "Chronic Valvular Disease of the Heart," and "The Diseases and Functional Disorders of the Stomach," are most instructive, and the section and subsections dealing with "The Diseases of the Nervous System" are written clearly, and will well repay perusal. The general structure and functions of the nervous system are explained in a simple and lucid manner, and will be found most useful to those who have got a little out of touch with cervical and spinal topography.

The section on "The Diseases of the Skin" contains a simple classification of the skin affections most commonly met with in practice. The appearances are clearly described, and treatment briefly and concisely given. The rashes produced by drugs are also dealt with.

Owing to the scope of the book, tropical diseases and parasites are not dealt with to any full extent, but the symptoms and treatment are briefly described. In the subsection on "Appendicitis" we think that the necessity for early surgical interference might be perhaps more emphasized.

The book is well printed, and of a convenient size. The concise and accurate nature of its contents, together with its comparatively small

bulk (a matter of consideration to medical officers) renders the book in our opinion, a very useful addition to an officer's library.

F. M. M.

Clinical Bacteriology and Hæmatology. By W. d'Este Emery. Fourth Edition. London: H. K. Lewis. Price 7s. 6d. net.

This fourth edition of Dr. Emery's well-known book differs but little from the third edition, except that a section on "Wassermann's Reaction" has been added. The fact that a fourth edition has been called for is sufficient evidence that the book has supplied a want, and indeed it is a most excellent handbook for the laboratory; the descriptions of technique are clear enough for even a novice to follow, while the inferences to be drawn from findings are given in a practical and very helpful manner. The work is intended primarily for the instruction of those who have not had much previous practice in the application of bacteriology and hæmatology to clinical work, but the expert also will find much useful information between its covers, and it is not too much to say that Dr. Emery's handbook should find a place in the library of every well equipped laboratory.

W. S. H.

Practical Chemistry. By Professor P. A. Ellis, Richards, F.I.C. Second Edition, 1912. Baillière, Tindall and Cox. Price 3s. net.

This little book is written more especially for medical and dental students, and contains all the subject-matter required in the new syllabus of the Conjoint Board Preliminary Science Examination, besides additional "detection tables" and a certain amount of volumetric analysis, arranged to meet the requirements of the Preliminary Scientific Examination of the London University. The special tests for the metals, acids, and organic substances are so arranged that the student should have no difficulty in acquiring a sound knowledge of the subjects. The separation tables given are clearly explained and serve well to elucidate the analysis of special mixtures containing not more than two metals and one acid radicle. The directions given for the preparation of certain salts are clear and devoid of unnecessary technical detail. They are of great importance in practical teaching and add considerably to the value of the book. The last part of the book has been devoted to some general reactions of the common poisons, a subject concerning which the ordinary student has often very little knowledge. Here, however, he has some very good practical hints which should form a sound basis for extended study in forensic medicine.

We are very glad to see that this little book has reached its second edition and can thoroughly recommend it as a sound practical elementary treatise on the subject.

W. W. O. B.

Current Literature.

Physiological Studies in Anaphylaxis.—W. H. Schultz (Public Health and Marine Hospital Service of the United States Hygiene Laboratory, *Bulletin*, No. 80), in considering the physiological aspect of anaphylaxis, notes the following facts:—

The injection of a small dose of protein into an animal renders it sensitive to a second dose, when a condition of anaphylactic shock is produced and immediate death may ensue.

The death of a guinea-pig during anaphylactic shock is due, in the first place, to asphyxia.

The asphyxia is the result of occlusion of the bronchioles, produced by contraction of the smooth muscles in the bronchioles, combined with some œdema of the mucous membrane.

Other symptoms of anaphylactic shock are: Fall of blood-pressure and subnormal temperature. These are the result of the contraction of the smooth muscle of the arteries and arterioles, causing an engorgement of the venous circulation.

Schultz considers that these statements are of considerable importance from a therapeutic point of view, and he has set himself the task of elucidating some of the problems that arise.

He points out that many substances containing proteins (sera, vaccines, gland extracts) are now used for therapeutic inoculations, which may serve the immediate purpose for which they are intended. But, he asks, what effect do they have on the various tissues? Do they leave the tissues in the same condition as before, or have they altered the protective mechanism of the tissues for other emergencies?

Everyone knows the extraordinary and severe symptoms present in anaphylactic shock, but Schultz points out that many tissues are greatly altered in their reaction, even when no immediate and visible reaction of the body is evident.

What influence has this hyperirritability upon the animal's resistance to disease; how does it influence the body's reactions towards ingested food protein, towards the action of certain drugs, and how does it handicap or aid the various organs in meeting an unusual condition? These are the problems that the author has set himself to work out.

This volume is the first report and is preliminary to the research paper. It makes interesting reading, as it contains an historical survey of work done on the physiology of anaphylaxis, and in particular of that dealing with blood-pressure, respiratory volume and reaction of muscle and nerve. The remainder of the report records and summarizes his own experiments in the reaction of animal tissues to different proteins, and forms the ground work for future reports.

When strips of smooth muscle are placed in oxygenated Ringer's solution peristaltic movements are set up, which can be recorded on a revolving drum. When serum or other protein is added to the solution the muscle quickly responds by a more vigorous contraction. This is found to hold good for segments of intestine from frogs, mice, cats, dogs, and guinea-pigs. The guinea-pig was the animal selected for the experiment, the results of which—so far—may be briefly summarized.

The smooth muscle of the uterus, bladder, aorta, vena cava, pulmonary arteries, systemic and possibly mesenteric arteries reacts in a similar manner to that of intestine.

The intestinal muscle of an animal sensitized to horse serum reacts to horse serum more vigorously than that of an intact animal.

Guinea pigs rendered tolerant to large doses of serum by repeated injections of serum (anti-anaphylaxis) yield muscle that reacts like that from a sensitized animal. Schultz points out that this would seem to indicate that while the tissue cells may be sensitized there is some mechanism whereby the animal is, as a whole, protected from the toxic action of the final dose of serum.

Guinea-pigs sensitized by a single dose of horse serum and after twenty or more days, desensitized by sublethal doses, yield muscle that shows a varying degree of irritability.

Schultz states that whoever has watched the reaction of highly sensitized guinea-pigs to serum, the bronchial spasm, intestinal movements and the emptying of the bladder cannot but be impressed with the idea that smooth muscle plays an important part in producing the visible symptoms of immediate anaphylaxis; and if it be his good fortune to test a sample of smooth muscle from some one organ the results emphasize more and more the importance of this tissue in serum anaphylaxis.

J. C. K.

Detection of Tubercle Bacilli in the Blood and Foci of Surgical Tuberculosis.—Duchinoff (*Beitr. zur klin. Chir.*, June, 1912, p. 1) gives a good summary of the work of former observers, which should be consulted by those interested in this subject. He employs the antiformin method of detecting tubercle bacilli. Antiformin is a mixture of equal parts of a 30 per cent watery solution of sodium hydrate, and liquor sodæ chlorinatæ B. P. Fluids, such as pus, blood, or urine, are digested with a 20 per cent dilution of antiformin in water. For fæces and tissues the strength is raised to 30 or 35 per cent. By means of antiformin, which emulsifies tissues, cells, &c., the tubercle bacillus can be distinguished from the smegma bacillus, for the latter is destroyed. Duchinoff thus summarizes his results:—

(1) The pus of chronic abscesses of serous membranes and joints in tubercular disease, contains tubercle bacilli, which can be demonstrated in every case by the antiformin method.

(2) The pus is not sterilized by iodoform injections, even if these are repeated several times.

(3) Tubercle bacilli can always be found in the serous effusions of tubercular joints and serous cavities.

(4) Tubercle bacilli in the dejecta arise either from a local focus, or from mixture with sputum or blood.

(5) The antiformin method is of great diagnostic value.

(6) Much perseverance is necessary to secure the detection of tubercle bacilli in glands. Inoculation of animals with the detritus left after antiformin treatment of the glands induces tubercle in them.

(7) The microscopical examination of the blood for tubercle bacilli was successful in 78 per cent of ninety-eight cases of surgical tuberculosis. If the phthisical patients were excluded, the percentage was 75.

(8) After operation tubercle bacilli were present in the blood of a large proportion of cases.

(9) The microscopical finding was confirmed by animal inoculation.

(10) The almost constant occurrence of the tubercle bacillus in the blood of those suffering from tubercular joint affections shows that the term "polyarthritis tuberculosus" may be correct.

(11) Tubercle bacilli exist in the blood of almost all cases of surgical tuberculosis. This infection of the blood-stream is not necessarily dangerous. A case is quoted which recovered after operation, though bacteræmia had been present before.

(12) By special staining processes tubercle bacilli can be discovered in the normal tissues of tubercular men and animals.

(13) The latent existence of tubercle bacilli in healthy tissues explains the frequency of surgical tuberculosis after injury.

C. B.

The House-fly as a Carrier of Typhoid Infection.—Lieutenant-Colonel F. W. Thomson (*Journal of Tropical Medicine and Hygiene*, September 16, 1912) has published a series of important experiments undertaken to investigate the rôle of the house-fly as a carrier of typhoid infection. His conclusions are summed up as follows:—

(1) The ingestion of typhoid germs in large numbers has no bad effect on the health of flies.

(2) Flies can retain living typhoid bacilli within their bodies, and transmit infection thereby for a period of twenty-four hours after ingestion.

(3) They can carry the living germs on the exterior of their feet or bodies for a period of six hours, and so transmit infection.

(4) As research tends to show that the *Bacillus typhosus* possesses no great saprophytic vitality, the presence of the germ in any substance or locality indicates its comparatively recent derivation from man, in whose excreta it emerges.

(5) Given the acute typhoid case, the convalescent, or the carrier, as a focus of infection, there may be many channels by which it is spread; but, as far as our knowledge takes us at present, it is quite possible that the common fly is a very important factor in the transmission of the disease through the contamination of food.

(6) It is advisable, therefore, to endeavour to reduce the number of flies by preventing their having good breeding places, and to keep food supplies, especially milk, under suitable protection from contamination by them. This is particularly important in regard to barracks of British troops in India, where the method of filth disposal by shallow trenches seems most undesirable from the fly reduction point of view, as it not only increases the number of flies in the vicinity of cantonments, but also turns them out ready filled with human excreta.

Peptone-free Culture Media.—C. Nicolle (*Comptes Rendus de la Société de Biologie*, November 1, 1912) has tested the value of the peptone which tradition tells us to add to nutrient media. He finds that its addition is unnecessary and at times harmful. Pathogenic and saprophytic bacteria which thrive on peptonized gelatine, agar and broth, grow almost as luxuriantly when the peptone is omitted. The typhoid and paratyphoid bacilli give cultures on peptone-free agar which emulsify more easily than when peptone is present; hence it is desirable to subculture these micro-organisms on peptone-free agar, when they are

required for serum diagnosis. Nicolle thinks that peptone should be omitted in the preparation of vaccines. C. B.

The Treatment of Locomotor Ataxy.—Leredde (*Münch. med. Woch.*, September 17 and 24, 1912) reports fifteen cases of tabes which he has treated with salvarsan. He holds optimistic views on the curability of tabes. In 1904 he published a work entitled, "La Nature Syphilitique et la Curabilité du Tabes et de la Paralysie Générale." Of the fifteen cases no improvement was noted in one. In two the lightning pains disappeared, and the knee-jerk was restored, hence he looks upon them as cures, though the tabetic symptoms had been present for four and six years respectively. Considerable benefit was observed in all the rest. The pains were alleviated; the inco-ordination became less; gastric crises occurred less frequently; bladder symptoms were ameliorated; a perforating ulcer healed. Only one relapsed. Leredde asserts that locomotor ataxy can be cured by the energetic and prolonged use of salvarsan or neo-salvarsan, though the disease may have existed for years. He administers a series of injections in the course of a month, consisting of 0·2, 0·4, 0·6, and 0·6 grm. of salvarsan, or corresponding doses of neo-salvarsan. After an interval of one or two months, he repeats the course. There may be aggravation of the pains as the immediate result of the injections, but this subsides after twenty-four hours. The first dose must be small, for Westphal, Orth, Ravaut, de Lapersonne, Leri, Martius, and Marcus have reported deaths of ataxic patients after one injection of salvarsan. Leredde continues the treatment until the positive Wassermann reaction and the clinical signs disappear. He states, however, that the conversion of a positive into a negative serum reaction is often difficult to secure. Moreover, the blood may become negative, while the symptoms remain, hence the salvarsan should not be discontinued solely because the Wassermann reaction is no longer present. More recently he has used neo-salvarsan with similar good results. C. B.

Treatment of Itch.—Stabsartz Dr. Has (*Deut. Militärärzt. Zeit.*, October 20, 1912) speaks highly of the following treatment for itch, which has yielded most satisfactory results in his hands:—

(1) The patient is rubbed down with soft soap and given a hot bath for half an hour.

(2) The following ointment is rubbed in: Precipitated sulphur 160 parts, menthol 4 parts, carbonate of potassium 40 parts, lanolin to make 1,000 parts.

(3) The patient is then put to bed for two hours.

(4) The ointment is again rubbed in.

(5) The patient is put back to bed for another two hours.

(6) A hot bath for half an hour.

(7) The following lotion is painted on the affected areas: Oxide of zinc, talc, glycerine, distilled water, equal parts by weight.

This finishes the treatment, but it is advisable to disinfect his clothes.

C. E. P.

Hydrocele in the German Army.—Oberstabsarzt Graf (*Deut. Militärärz. Zeit.*, October 20, 1910) has examined the German Army statistics with a view to determining the influence of injury in producing hydrocele. The incidence in the army is roughly 0·3 per 1,000 of

strength. During the last ten years, 1,034 cases were reported; of these 790 were hydrocele of the testis alone, and in only 32 cases were both testes affected; hydrocele of the cord occurred in 231 cases and hydrocele of both the cord and testis in 13 cases. The right side was affected in 62 per cent, the left side in 3·49 per cent, and both sides in 3·1 per cent of the cases.

In 437 (42·2 per cent) of the cases the hydrocele was due to injury; of these 271 (= 62·1 per cent) were on the right side. The injuries were either direct, such as a kick, pressure on the saddle, &c., or indirect, due to lifting heavy weights, &c. The hydrocele in most cases began to form from the third to the tenth day after the injury.

A radical cure was performed in 416 cases, of which 410 were completely successful. Puncture with or without the injection of irritants was carried out in 177 cases, of which 115 were cured.

C. E. P.

Treatment of Snake-bite by Permanganate of Potassium.—The results of an investigation carried out by Surgeon-General Bannerman, I.M.S., into the treatment of snake-bite by permanganate of potassium, have been published in the *Indian Medical Gazette* of October, 1912.

Surgeon-General Bannerman's conclusions are as follows:—

"The conclusions as to the action of potassium permanganate powder on small doses of cobra venom injected *just under the skin* appear to be that this treatment is of some little use under these highly artificial conditions. It must be remembered, however, that a snake does not deposit its venom under the skin, but striking as it does with its fangs at right angles to the skin, the poison must usually be placed well below the fascia of the part, and therefore further removed from the applications of a chemical antidote." "With regard to daboia venom injected just under the skin, the results are very similar to those obtained with the venom of the cobra, i.e., that under such artificial conditions the treatment by free incision and rubbing with powder of potassium permanganate is of some little use. As a practical measure for employment after actual snake-bite it appears to be of no use whatever."

C. E. P.

Cooking Wagon.—During the recent militia manœuvres in America the 71st New York National Guard regiment provided itself with a luxurious type of travelling field kitchen. The wagon, when fully loaded with rations, &c., weighed some 2,600 lbs., and was drawn by four mules. The back portion of the wagon was arranged to carry two large cookers, which slid into their places on the top of a range. When the food they contained had been heated to sufficient temperature these cookers were further slid into asbestos casings. These were then securely closed, and the food would continue cooking for several hours. It was generally in the form of a stew. Four hundred rations were cooked at a time.

The forepart of the wagon was fitted with an ice-box in which the uncooked rations were carried. It also contained sufficient space to carry two cooks, and an arrangement by which they could cut up meat while the wagon was on the road, also a cupboard was provided in which to carry groceries, &c.

The whole arrangement was very complete, and gave entire satisfaction, the men never being without a hot meal on arrival in bivouac.

The regiment had three of these wagons, which cooked for the whole of the men.

C. E. P.

Care of Teeth in the German Army.—Stabsarzt Dr. Tüshans (*Deut. Militärärz. Zeit.*, October 20, 1912), in charge of the dental division of the garrison hospital at Munich, has read a paper reviewing the present position of dentistry in the German Army. Among school children, from 78 to 98 per cent were found to be suffering from some form of dental caries; a large number of soldiers were examined, of whom only 6 per cent were found to have perfect teeth. During the last ten years some 450 recruits have been examined annually in the dental division of the garrison hospital at Munich and the results show that, taking the average, each recruit had five carious and two missing teeth.

All N.C.O.'s and men belonging to the army can now obtain dental treatment when ordered by a medical officer. When this treatment cannot be given by the specialist medical officer in the garrison hospital it is provided under contract by fully-qualified dental surgeons. At present there are twenty-five army medical officers specially qualified in dental surgery, and dental divisions have been established in twenty-two of the large military hospitals. During the year 1910-11 there were 25,300 attendances in the dental divisions, although some of the divisions were only opened late in the year. Artificial dentures are only supplied when teeth have been lost in and by military service, or in certain circumstances to prevent a man from becoming inefficient through the loss of his teeth. C. E. P.

Toxicity of Alcohols.—Maggiore Medico G. Conte (*Annal. Med. Nav. e Col.*, vol. i, 1912, p. 514) has published a series of experiments undertaken to determine this question. The alcohols were injected into dogs intraperitoneally, subcutaneously, intravenously, and into the margin of the ear. His conclusions are as follows:—

(1) All alcohols and their derivatives have a toxic action. (2) The dose of each alcohol capable of producing acute intoxication varies according to the channel of introduction; all are less intoxicant if subcutaneously introduced; but some alcohols are more toxic if introduced intravenously, others if introduced intraperitoneally. (3) Dilution does not decrease toxicity, but, on the contrary, in the case of some alcohols (normal butyric) increases it. (4) In order of toxicity alcohols follow the law of Richardson; the same cannot be said of their derivatives, such as aldehyde, which, having a very low molecular weight, shows itself very toxic. (5) Higher alcohols produce a poisoning whose prevailing character is depressant and convulsive, as other authors have already pointed out. (6) The impurities existing in ethylic alcohol and spirituous beverages render these very toxic, especially if they are of the character of aldehydes. (7) In chronic intoxication alcohols act deleteriously on the liver and kidneys, causing nephritis and parenchymatous hepatitis. These changes occur earlier with alcohols having a high atomic formula (amylic alcohol). (8) The injection of dilute ethylic alcohol into the vena porta produces characteristic toxic hepatitis and marked interstitial nephritis. (9) The essences generally to be found in commerce, even in doses which largely exceed those ordinarily used, have no toxic action.

H. E. R. J.

Water Sterilizing Cart.—Méd.-Major Garret and Captain Balambois (*Le Caducée*, November 16, 1912) have designed a water-sterilizing cart for which they claim several advantages. The cart is a two-wheeled one, drawn by one horse; it carries a boiler and a water tank, the latter

contains a coarse filter. When a large quantity of water is required at short notice, it is sterilized in the tank by chemical means. When there is no great hurry, the water is filtered and boiled; water required for surgical operations can be sterilized at 133° F. The plant has a capacity of 500 litres per hour. The heat from the boiler can also be used for the dry sterilization of dressings. The apparatus is to be tried in Morocco.

C. E. P.

Notes on Wounds Observed at Derna.—Surgeon-Captain E. de Sarlo (*Giorn. Med. Milit.* Fasc., IV, 1912) wrote a lengthy report of his experiences extending over five months in No. 2 field hospital at Derna, from which the following notes have been taken.

The Turks and Arabs used a variety of rifles, but mainly Martini-Henry and Mauser of 1890 with a nickel steel bullet of 7·65 mm. calibre. The large lead bullets caused severe wounds with considerable deformity, which at first gave rise to the suspicion that the Turks were using some form of expanding bullet. Subsequent experience showed that this was not so. The large leaden bullets are very apt to carry fragments of clothing into the wound and so cause severe septic infection. On account of the large wound of exit severe hæmorrhage was frequently observed and hæmatomata were uncommon.

Wounds by small-bore bullets were not usually septic. In one case a man was wounded in the left parietal region, and the bullet lodged within the skull. There was a circular wound of the skull with considerable bruising and fragments were sticking into the brain substance; there was no hemiplegia. The area was disinfected with tincture of iodine, the wound enlarged, splinters removed and the wound partially closed. During convalescence there was marked ataxia pointing to injury of the cerebellum, this gradually disappeared and the man was finally discharged cured.

In wounds of the chest caused by leaden bullets hæmoptysis was usually present, but was slight and of short duration; only a mild degree of hæmothorax was noted. Small-bore bullet wounds (Mauser 1890) of the chest were not accompanied by pneumothorax or subcutaneous emphysema.

To show the endurance of the Arabs de Sarlo related the following instance: An Arab who had been wounded by a bursting shell was brought to the hospital. On admission he presented a large wound of the abdomen with a protruding mass of omentum and intestine, the latter wounded in several places; his right hand had also been blown off and there were a number of other minor injuries. Laparotomy was at once performed without an anæsthetic; the intestines were sewn up, washed and returned to the abdomen. The laparotomy wound was partially closed and a drainage tube inserted. The right forearm was amputated in the lower third. The patient watched the whole surgical work being carried out without uttering a groan and at the finish thanked the operator profusely. He then insisted on being carried to a neighbouring hut, where he at once began to eat dates.

In practically all cases tincture of iodine was used as a disinfectant. The results were most satisfactory; when used alone it never gave rise to symptoms of irritation, but when used in conjunction with sublimate gauze it was found to cause severe irritation.

De Sarlo pointed out that the prognosis of a wound depends very largely on the treatment first applied to it. If soon after its infliction

the wound can be protected by an aseptic dressing, infective complications will almost certainly be avoided. In abdominal wounds there is always great shock and as a rule laparotomy should be postponed. The only indication for early laparotomy is when internal hæmorrhage is taking place, otherwise the routine treatment should be complete rest, morphia and starvation.

De Sarlo from his experience gives the percentage of wounds of different regions as follows: Head, face and neck = 13·8, thorax = 14·4, abdomen = 12·2, pelvis = 8·9, upper extremities = 14·9, lower extremities = 35·1.

C. E. P.

A Report on the Work of No. 1 Field Hospital at Bengasi.—Maggiore Medico Santucci (*Giorn. Med. Milit.*, Fasc. vii, July 31, 1912) has published a short account of this hospital, which contained 100 beds and was established in the buildings of the Italian Archæological Mission in October, 1911.

The first step was to form a dressing room, an operating room, a reception room for sick. As the arrivals increased the accommodation had to be enlarged; four Baumann tents, a Guida tent and tents for the medical officers were pitched. Later two huts were constructed, each capable of holding fifty beds, and finally a large accessory hut of 140 beds capacity on the Piazza del Sale near the main part of the hospital. As it stood the hospital could ordinarily receive 250 sick. At the same time the various general services of the hospital were instituted; these soon had to be increased owing to the growth in the size of the hospital.

The average daily cost per case, exclusive of the medicines sent from Italy, was 2·66 lire (2s. 2½d.) per case treated. Though there was a considerable flow of sick the cost for the washing of linen, which was economically done by the hospital personnel, did not exceed 500 lire (£20).

The Medical Division at first occupied some rooms inside the building and two Baumann tents. Then, as the sick increased, it was subdivided into three sections, two accommodated in two distinct wards in the accessory hut, and one in the principal room in a separate hut, and in two tents.

The Surgical, Venereal, Skin Division.—This division also, which at first occupied some rooms in the building and two tents, was afterwards allotted to one of the two huts of the main body of the hospital. It had at its disposal a good operation room, a room for aseptic dressings, and one for ordinary dressings. It was given two Schimmelbusch sterilizers, one for instruments and one for materials for dressings, and an autoclave of the Abba model. Linen for use in operations was kept in bags of Olona cloth and sterilized in the Giannolli apparatus.

Lumbar anæsthesia was used in fifty-nine cases of operation.

Radiographic Installation.—The field model of Ferrero's apparatus was located in the interior of the buildings and was found of great utility in clinical investigation. A small dark room for the development of the plates was established in the same place.

Officers' Ward.—The officers who were seriously ill were put in a separate division in the main hospital consisting of two large rooms separated by a wide passage; the less seriously ill were treated in an accessory hut, consisting of six rooms each containing one to two beds.

Out-patient Department.—An out-patient department for natives was instituted two days after the disembarkation, first in a Guida tent, then in a little hut near the centre of the hospital, finally in a room conveniently situated and connected with the accessory hut. Medicines and food were distributed among the more needy of the natives gratuitously, and flour and surplus rations of the soldiers of the detachment and the sick were given to the poor.

The Pharmacy was first placed inside the building of the Mission; as the needs of the hospital increased and the pharmaceutical work for officers of the cantonment had to be undertaken, the pharmacy was transferred to the place previously occupied by the native out-patient department near the hospital itself. It was furnished with shelves, counter and necessary apparatus for carrying on its work; it has a distributing room, a preparation room, a store for ordinary materials, a room for poisons and alcoholic substances, and an inner court. In addition to performing the work of the hospital and cantonment it has done a great deal for the native poor.

Kitchens.—Two kitchens were established, one for sick and personnel of the hospital corps and one for the mess of the medical officers and the sick officers. The troop kitchen, at first constructed in an inner court, has now found its place in a large room where the necessary fittings and alterations have been made. Next to the kitchen an issuing room has been arranged. A kitchen already existing in the Mission building was used for the officers' kitchen.

Water.—The drinking water supply is carried out by means of casks, which are daily brought up on carts from the wells at Foiat to the hospital. The water is transferred by means of a pump directly from the casks on the carts into a system of covered reservoirs placed in the interior of the building, arranged in series and consisting of three large casks lined with cement; the first reservoir is furnished with a filter made of layers of gravel, sand, charcoal, and wood. A supply of sterilized water has since been arranged for. Also, two Norton wells of about six metres depth have been made, one in the middle of the principal court-yard and the other in the yard of the hutment on the Piazza del Sale. They yield brackish, but clear water, which is used for common purposes, including laundry work.

Laundry.—A hospital laundry with a drying ground was established from the first, on the north side of the principal open space. It is provided with a copper and several tubs. Four stretcher bearers of the detachment are employed there.

Ablution Place for Sick.—On the east side of the open space near the laundry is a wooden ablution bench with five waste water pipes for the use of the sick; water from the nearest Norton tube well is used there. Two other lavatories of wood have been constructed in the courtyard of the hutment on the Piazza del Sale.

Disinfection is carried on by means of a mobile apparatus of the Giannolli model, and vacuum pumps of Gatteschi type. The Giannolli apparatus deprived of its wheels is fixed in a hut near the laundry. The hut is divided into two compartments, one for infected materials, the other for the disinfected. A corporal major mechanic is in charge of the apparatus.

Mortuary.—This is made of wood; it is situated away from other buildings near the disinfection apparatus.

Latrines.—For the sick officers a latrine already existing on the first floor of the building is used. For sick soldiers under treatment in the interior of the building a portable receptacle of galvanized zinc plate contained in a wooden case and provided with a cover is used. For the sick in the tents, and during the daytime for those in the huts in the principal part of the hospital, a trench of a capacity of about six cubic metres has been dug, with an absorbent bottom, and covered by a seat with four openings. This latrine is located in a place near the hospital compound, from which it is separated by a surrounding wall in which a doorway has been made. In one corner of every hut, moreover, a portable latrine (commode) is placed for night use in a small compartment; it is lined with zinc plate, and can be removed for emptying from outside the hut. Latrines on the same system are fixed in the accessory wards for sick officers for the two sections of the Medical Division and for the men of the detachment. The regular emptying of such latrines is carried out by two natives, who are paid.

The Clothing Store.—At first this was established in a room near the entrance; it quickly became too small, and was transferred to a large store-room near the main building, which communicated by means of a door with the interior of the hospital. To avoid scattering, and to keep the kits of the sick from dust, the store was fitted with a series of numbered bags corresponding to the number of the beds, into which the kits of the individual sick were put.

Lighting.—A Pozzi acetylene generating apparatus was instituted in the inner court for the lighting of the court itself and the operating room. Afterwards a larger acetylene apparatus was set up which was capable of illuminating the whole of the hospital. H. E. R. J.

Red Cross Societies and the Balkan War.—The German Red Cross Society (*Das Rote Kreuz*, November 10, 1912) has despatched the following units to the War, the first of these started on October, 1912. *To Bulgaria:* One detachment consisting of 2 medical officers, 2 sick attendants and 4 sisters. *To Turkey:* Two detachments—the first comprised 2 medical officers, 4 sick attendants and 2 sisters; the second had 3 medical officers, 4 attendants, but no sisters. *To Greece:* One detachment composed of 2 medical officers, 2 attendants, and 8 sisters. *To Servia:* One detachment made up of 3 medical officers, 4 attendants, and 6 sisters.

Each detachment took with it the complete outfit for an operating room and a large supply of dressings. The Bulgarian detachment took in addition, at the request of Queen Eleonora, 500 blankets and 600 mattress cases. The detachments were received in audience by Her Majesty the Empress, who wished them God-speed.

The Austrian Red Cross Society has despatched a field hospital of 50 beds to Cetinje, Montenegro, with a staff of 2 doctors, 15 attendants, and 6 sisters. The Society has also sent a field ambulance with a staff of 2 doctors and 6 attendants to Podgoritza, and another with 2 doctors and 10 nurses to Bulgaria. Dressings to the value of £250 have also been sent to the Ottoman Red Crescent Society.

The Russian Red Cross Society has sent two hospitals of 50 beds each to Montenegro; it has also in readiness 2 hospitals of 200 beds each and 7 field hospitals for other parts of the theatre of war. The Society has expended £10,000 on these preparations.

The Italian Red Cross Society has sent a large supply of dressings

to Greece and Montenegro; it has also decided to fit out several field hospitals.

The Swedish Red Cross Society has sent a fully equipped ambulance to Greece. C. E. P.

Correspondence.

THE SPIDER'S WEB IN MALARIA.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—The Spider's Web treatment has a strong advocate in Thomas J. Graham, M.D. ("Modern Domestic Medicine," 7th edition, 1837, pages 78, 240-241).

After warning the medical man against the fashion of prescribing *poisons* he states he would like to introduce one "simple" remedy to the confidence of his readers: "The cobweb of cellars, barns and stables is a valuable remedy for ague," &c. . . .

"Some American physicians, who have taken it, say it produces a calm and delightful state of feeling, succeeded by a disposition to sleep."

On p. 240 on Ague: "Dr. Jackson was for fifty years in the medical department of the Army, &c. . . .

"He was well known to the profession as one of the most attentive and accurate observers, as well as one of the most judicious and successful practitioners."

Dr. Jackson is quoted as follows:—

"I think I may venture to say that the cobweb prevents the recurrence of febrile paroxysms more abruptly and more effectually than bark or arsenic or any other remedy employed for that purpose with which I am acquainted," &c.

This is indeed remarkable testimony of a now discarded form of treatment.

Was this empirical treatment a foreshadowing of our present day organo-therapy, or was it some form of antitoxin treatment?

Was it the secretions of the spider or the excretions of his parlour visitor that acted like a charm on the malarial parasite?

Apropos of the spider's web we had a Gunner Major in West Africa who encouraged and cultivated the spider and his web in the barrack rooms, as he considered they kept away the mosquitoes.

Such was his faith in the spider's web that he had one tattooed on his bald head to frighten the dreaded anopheles away, and he looked on himself as quite immune on that account.

As our author's frontispiece says:—

"The subject of man's body is of all things the most susceptible of remedy, but then that remedy is the most susceptible of error" (Bacon).

I am, &c.

Tralee, F. P. LAUDER,

December 16, 1912. *Major R.A.M.C.*

No. 2. February, 1913. Vol. XX.

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL W. H. HORROCKS,

ROYAL ARMY MEDICAL CORPS

ASSISTED BY

MAJOR C. E. POLLOCK,

ROYAL ARMY MEDICAL CORPS

ISSUED MONTHLY

Printed and Published by

JOHN BALE, SONS & DANIELSSON, Ltd.

OXFORD HOUSE,

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W.

Price Two Shillings net.

VOLUME XX. FEBRUARY, 1913. No. 2.

Journal

of the

Royal Army Medical Corps.

Original Communications.

THE NATURE AND DETECTION OF APYREXIAL MALARIA.

By COLONEL R. H. FIRTH.

To this Journal[1] an important and suggestive article was contributed by Major G. E. F. Stammers, R.A.M.C., and Captain G. I. Davys, I.M.S., entitled "Apyrexial Malaria Carriers." It is questionable whether the significance of this condition is quite appreciated by us; certainly, anyone having the practical experience of analysing critically the statistics and epidemiological data connected with malaria incidence among troops cannot fail to be impressed with the view that, in this question of malaria incidence, its prevention and control, there is a potential factor as to which we apparently know little and have possibly ignored too long. The factor seems to be the condition which may best be described as dormant malaria. If this assumption be correct, either wholly or in part, the need for its early detection is obviously an important step in the procedure by which we hope, and are endeavouring constantly, to control or minimize military inefficiency from paludal infection. As an elementary and supplementary effort towards emphasizing attention to this subject the following considerations are submitted.

Our first difficulty is to define or explain what we mean by

[1] Vol. xviii, p. 268.

dormant malaria. Circumstances have precluded one making any exhaustive examination of the literature on malaria, but such examination as one has made affords little information; in fact, the conclusion drawn is that the condition has been ignored by most writers, but referred to by a few, notably by Christophers, Stephens, and Plehn. For practical purposes, we may say that dormant malaria is that apyrexial period in a malarial infection during which the parasites are still in the peripheral blood or deeper organs, but not present in the asexual stage in sufficient numbers to cause the clinical phenomena of fever or ague.

In spite of the large amount of work which has been done on malaria and the great attention which all our officers are devoting to its nature and prevention, it is open to doubt whether the current teaching on the subject emphasizes enough the distinction between incubation, recrudescence, and relapse in malaria cases. Each of these is a state associated with malarial infection and, so far as relates to the condition of dormancy, each suggests a distinctive phase. By incubation, one refers to that apyrexial stage intervening between the time of the introduction of the sporozoites by the mosquito to the time when the asexual parasites are present in sufficient numbers to produce the first attack of fever. We all know that this period ranges from one to seven days in the malignant tertian infections, and from twelve to eighteen days in the benign quartan infections. The taking or not of quinine will affect this period; in many cases, if the amount of quinine taken be efficient the infection may terminate at this stage, or if the dosage be insufficient the attack its merely deferred. We need precise information as to this last contingency among soldiers who have been under prophylactic cinchonization. It has been part of my duty to examine critically the malaria returns of garrisons and units; the notable rise in numbers of malaria admissions during October and November suggests that we have here evidence of delayed or prolonged incubation, in other words, insufficient prophylaxis.

By recrudescence of infection one means that increase in the number of asexual parasites sufficient to produce an attack of fever, these asexual forms having already existed in the infected person. We can conceive a phase of dormancy in recrudescence, during which the asexual parasites are multiplying, although not present in sufficient numbers to cause fever. How long this dormancy may exist will vary according as to whether the host is under quinine treatment or not. In untreated persons this may

run from seven to fourteen days, and in the treated cases this afebrile or latent period may range from extreme irregularity to one or more months. A serious practical question is the great difficulty of detecting asexual forms in the peripheral blood during these periods of dormancy in recrudescence of infection. It is some time now since one did much examination of blood smears, but one is told the best chance of detecting the few asexual forms to be found in this condition lies in the use of the thick film method of Ross. One has had no experience of it, as it is a development later than my laboratory days.

We come now to the more difficult question of relapse of infection by malaria. Few writers recognize the essential distinction to be drawn between a relapse and a recrudescence of infection; there is reason to think that most men confuse the two events or regard them as identical. There is much to suggest that there is a definite difference. In attempting to argue that there is such a difference one is conscious of one's own ignorance and lack of recent experience in this field of work; but the more one thinks over what little one does know, the more one is impressed with the idea that some common clinical incidents of everyday life are not wholly explicable by the orthodox or simple conception of a recrudescence of infection. The problem is, how can one explain such a case as this? A man contracts malaria and presents the classical symptoms, his blood swarms with asexual parasites. Assuming that he is not treated with quinine he will acquire, after ten days or so, and does acquire a certain amount of immunity, and sexual forms make their appearance in his peripheral blood, followed by a cessation or abatement of his pyrexia. These sexual forms increase and ultimately replace the asexual forms. Such a man may remain free from any ague attack for a considerable time when suddenly, following a chill, he develops an attack of fever simultaneous with the appearance of asexual forms in his peripheral blood. Cases of this kind are not uncommon, and exemplify what may be termed a relapse rather than a recrudescence of infection. The sequence of events may be described biologically as a relapse to schizogenesis after a mutation from schizogenesis to sporogenesis. It would be interesting to know whether such an explanation is supported by collateral technical evidence. If it is, then the synchronous appearance of zoites and gametes in the peripheral blood of a malaria-infected person, who has been free from attacks for some time, would be the signal that a relapse was imminent. Discussing

this view with men who claim to have considerable experience of malaria, one has elicited only unsympathetic comment; in spite of this, one has failed to hear a satisfactory alternative explanation, therefore the idea is put forward for what it is worth.

If the foregoing arguments are sound, it follows that the question of malarial apyrexia or dormancy assumes a serious importance, quite apart from other evidence, such as that given by Stammers and Davys. We therefore must endeavour to detect these dormant forms of malaria as, if we ignore or overlook them, we are leaving certain points in our defences unguarded. The question is, How can we best detect them? It is clear that the ordinary routine of peripheral blood-smear examinations will fail us. Looking through recent malaria literature, one finds a suggestion by Thomson[1] which deserves notice in this connexion. As the outcome of his work on the leucocytes in malarial infections, Thomson has formulated the following conclusions: (*a*) That during the course of active malarial fever the number of the leucocytes in the peripheral blood is below normal, and varies more or less inversely with the body temperature; (*b*) that in malarial fever the curve showing the percentage of total mononuclear leucocytes is an exact inverse of the temperature curve; (*c*) that in apparently cured malarial cases transient periodic leucocytoses occur in the peripheral blood, and these leucocyte fluctuations arise mainly from a polynuclear leucocyte variation; (*d*) that these leucocyte phenomena seem to be an infallible index of previous malaria, and are not observable in any other disease. We have, therefore, in this procedure of a total leucocyte count for leucopenia or leucocytosis coupled with a differential leucocyte count a valuable means of detecting dormant forms of malaria. Owing to the violent fluctuations often met with, a single daily count will be of little value. The counts must be made at five or six-hour intervals, covering two or three days. A case of apyrexial anæmia of an obscure nature came under notice in my own family recently in which there was no reason to suspect malarial infection. A series of blood examinations indicated a definite fluctuating leucocyte count, with a high mononuclear percentage at the leucopenic stage. This leucopenia varied from 3,300 to 6,800 per cubic millimetre. The subsequent history of the case confirmed the view of malaria in that parasites were found later in the

[1] Thomson, "Annals of Tropical Medicine and Parasitology," vol. v, No. 1, p. 83, April 20, 1911.

peripheral blood, though absent during the earlier stages, and the pyrexia developed a true paludal type, succumbing readily to quinine. The person in question was living in a mosquito-free area, and it was possible to exclude definitely any conception of recent infection. There was a history of old infection with a long interval devoid of fever.

In cases of this kind corroborative evidence is to be obtained as to destruction of blood by means of a test suggested by Plehn.[1] It utilizes the greater or less presence of urobilin in the urine. This pigment is not found in the urine of healthy persons, but can be detected in pneumonia, enterica, suppurative hepatitis and cases of anæmia, whether secondary or primary. According to Thomson, urobilin does not occur during the dormancy of incubation in malaria, but shows itself with the onset of pyrexia, and reaches its maximum some two days after the fever. Its detection is very easily carried out by adding to the urine an equal volume of a saturated solution of zinc acetate in a test-tube and shaking vigorously. Next add from 5 to 10 drops of iodine, such as is used in Gram's stain, and then stir or shake. The mixture is next filtered through filter paper, and if urobilin is present the filtrate shows varying intensities of fluorescence in proportion to the quantity of urobilin. At one time I constantly used this test on a relative in whom a small liver abscess was suspected. Thomson says that the urobilin content remains at a high level during the dormant period of malarial recrudescence, and that during the dormant period of relapse it tends to fluctuate violently, rising at first to a high level and then falling. There is reason to expect a higher elimination of this pigment in the malignant than in the benign infections by malaria. Quinine may raise the output at first, but once a person is cinchonized the drug does not affect the pigment elimination. The rationale of the urobilin test is obvious. It is but a measure of the amount of hæmoglobin eliminated by the urine, which disintegrated pigment is but an index of the degree of blood destruction taking place, or which has taken place in some part of the body. The ratio of the one to the other is known and may be put at 1 grm. of urobilin from each 25 grm. of hæmoglobin broken up. Of course, the presence or absence of urobilin is not a specific index of malaria, and is in no way equivalent to the detection of parasites in the blood; but as an indirect clue to what metabolic changes are going on in the body, the presence of

[1] Plehn, *British Medical Journal*, 1908, vol. ii, p. 1357.

urobilin in the urine constitutes a valuable test for the existence of malaria in apyrexial states. By itself the urobilin reaction has little value. A positive result indicates that blood pigment is being destroyed somewhere, and assuming by other evidence the elimination of other diseases, if there is no pyrexia the patient is in all probability in the malarial apyrexial or dormant state. Conversely, if there be no urobilin, then either blood destruction is not going on, or if it is then the liver is still capable of coping with the products of hæmoglobin disintegration. If malaria be suspected, then in such a case other evidence must be sought.

These aspects of this question are brought forward to focus attention on the apyrexial malarial state, and incidentally to call attention to means by which the condition can be detected. That detection is necessary is obvious; and once detected the suspected individual must be regarded as potentially a menace and handled on recognized principles. The logical deduction to be drawn from the facts is, that one more duty is added to the sphere of our activity; it is incumbent on us to carry it out.

Postscript.—Since writing the above, information reaches me that the urobilin test, as suggested by Plehn, has been extensively employed in India in the examination of apyrexial malaria by Major Harvey, Captain Knowles, and Captain Acton, all of the Indian Medical Service. Their work in this direction is said to confirm largely the views of Plehn, whose article on the detection of dormant malaria deserves serious consideration by all engaged in the treatment and control of malaria. The later work of the above-named Indian workers should be of great value as helping towards a clearing up of this vexed question.

PRELIMINARY NOTE ON THE TREATMENT OF GONORRHŒA WITH HEATED BOUGIES.

By Majors L. W. HARRISON and G. J. HOUGHTON.
Royal Army Medical Corps.

It is well known that the application of chemical antiseptics to the urethra fails to cure gonorrhœa because they do not reach the gonococci which are lying safely under the epithelium and within the numerous follicles and ducts which open into the urethra.

Another agent which is more penetrating and particularly destructive to the gonococcus is heat. Under artificial conditions the gonococcus is destroyed at a temperature of 104° F. in six hours, and at higher temperatures in a considerably shorter time. Under natural conditions it is a common observation that when a patient suffering from gonorrhœa develops pyrexia from any cause the discharge frequently ceases, and numerous cases are now on record in which the onset of severe pyrexia brought the gonorrhœa to an abrupt termination. The experiments in which Finger, Ghon and Schlägenhaufer failed to infect with the gonococcus patients who were suffering from pyrexia are well known.

It is perhaps surprising that more advantage has not been taken of this weak spot in the armour of the gonococcus since, if the heat is gradually applied, patients can sustain in the urethra a temperature of 114° F. to 119° F. From experience, workers probably feared that the passage of an instrument along the acutely inflamed urethra would be rapidly followed by epididymitis.

The indirect application of heat by means of sitz-baths, which has been advocated by many, could hardly be expected to succeed owing to the large area of diffusion. By more direct methods, Kyaw (*Med. Klin.*, November 10, 1912) has claimed considerable success from the use of diathermy, but this could have only a limited application owing to the great cost of the necessary apparatus. In his later cases Kyaw has used a bougie through which hot water circulates, and claims even better results from it than with diathermy.

The use of water-heated bougies in the treatment of gonorrhœa was suggested to one of us (G. J. H.) some years ago by Dr. J. A. Valentine, of Silchar, and, following on a private discussion on methods of attacking the gonococcus, we decided to make a cautious trial of a bougie made on the same lines as that used by

Dr. Valentine, trusting that by keeping the patient under the influence of atropine no epididymitis would follow.

Briefly, this instrument consists of a silver catheter (No. 9 or 12 English), with no opening at its distal end; into it is passed another catheter (No. 2), which is open at both ends, the distal end being about an inch from the corresponding end of the enclosing catheter. The two tubes are soldered together at their proximal ends so as to make a water-tight union, and the inner tube projects an inch or so from the outer. The latter is provided close to its proximal end with a short branch tube to lead away the water. The water from an irrigator flows down a suitable rubber tube (which is provided with a clip) to the inner metal tube of the instrument and is conducted by it almost to the distal end of the enclosing catheter, by which it returns to the branch tube; to this is attached another rubber tube to conduct the water to a bucket.

The treatment is applied as follows: On the previous evening and the same morning an atropine suppository (gr. $\frac{1}{75}$) is administered, and before the bougie is passed the urethra is irrigated in the usual manner. The patient is then placed on a couch and adequately protected with a water-proof sheet. The sterilized and lubricated bougie is connected up to the rubber tubing leading from the irrigator, which is itself placed about 18 in. above the couch and filled with water at 114° F. The bougie is then gently passed into the bladder and the clip opened to allow the water to flow from the irrigator. The temperature of the water in the irrigator is raised to 118° F. by adding more hot water to it, and after a few minutes it is gradually raised in a similar manner to 121° or 122° F. After two or three more minutes the temperature of the water in the irrigator is again gradually raised to 125° F., and this is maintained for five to ten minutes. At this temperature the outflowing water is generally 118° F. At higher temperatures than this blistering of the meatus may follow.

There is naturally great discomfort when the bougie is first introduced, and the patient bears the maximum temperature with considerable difficulty, but after seeing the results in the first few cases all our patients have submitted willingly to the treatment.

We have also used for the same purpose an electrically-heated bougie devised for the treatment of urethral stricture by Dr. Ph. Kobelt (*Münch. med. Woch.*, No. 30, 1912). With this instrument, which is provided with a thermometer, it is possible to regulate the temperature to a nicety so that it can be increased very gradually,

but its cost is greater and, of course, it requires some source of electricity (accumulator or main), with a suitable resistance.

It is at present too early to state how frequently the treatment should be applied so as to obtain the best results. So far the bougie has generally been passed on two or three successive days and subsequent applications have been determined by clinical progress and the presence or otherwise of gonococci in the urethral discharge.

Results.—We have treated in this way sixteen cases, eleven acute, with profuse purulent discharge, and five subacute or chronic, with watery discharge, and have made many microscopical examinations of the urethral secretion; in all cases this contained numerous gonococci before the treatment was commenced. The most striking effect has been the rapid disappearance of the gonococci in most of the cases. In six (four of them acute), none could be found by the fourth day after the first application of the treatment; in two (one acute) they finally disappeared on the seventh day; in another (acute) they did not finally disappear till the eleventh day, but only a single pair could be found on the seventh day. In two cases (acute) massage of the anterior urethra on the fourth day failed to produce any secretion and no microscopical examination was made; in two (subacute) microscopical examination was inadvertently omitted till the sixth and thirteenth days respectively, when no discharge could be obtained. In three cases gonococci still persisted up to the time of writing. In one of these (acute) no gonococci were found on the seventh, but a few pairs on the fourteenth and nineteenth days. In the second, treatment was commenced on the twenty-first day in hospital, when three large peri-urethral infiltrates were present and a profuse purulent discharge in which gonococci swarmed; by the ninth day, the number of gonococci had greatly diminished, the discharge was very scanty and the infiltrates were the size of small shot. In the third case (acute) a few pairs only could be found on the sixteenth and no discharge could be obtained on the seventeenth day. As to other elements, the chief feature has been an immediate increase of mucus and epithelium, the latter to a slight extent.

Clinically, in all cases the discharge has changed at once to muco-purulent or muco-serous. We did not expect it to cease rapidly after such treatment, but in six cases (four acute) it had disappeared before the eighth day, and in the remainder it was quite serous by this time. Stout was administered to all cases after disappearance of the discharge and caused no reappearance

of symptoms. In contrast to the majority of gonorrhœa cases treated by routine methods, the prostate has remained normal to palpation in all the early cases, and in others it has returned to normal. No case of epididymitis has occurred; on the contrary, in a more recent case than those mentioned above a patient with subacute epididymitis on admission showed marked improvement on the day after the first application of the treatment.

Summary.—Our experience of this method of treating gonorrhœa is too recent to permit us to draw any definite conclusion as to its ultimate value, but we think the above results give grounds for hope that it will prove a distinct advance on other methods. So far it has not only proved quite free from danger as regards the production of complications, but such local gonococcal complications as we have met have been favourably influenced by it. The most favourable feature is its effect on gonococci, and it is reasonable to hope that with further experience and a more perfect technique we may destroy these and convert the gonorrhœa to a transient urethritis even more rapidly than we have yet succeeded in doing. Very possibly such a mild urethritis as remains after the gonococci have disappeared may prove no impediment to a soldier's discharge to duty.

NERVE SURGERY.

By Captain T. J. MITCHELL.
Royal Army Medical Corps.

Cases which require operation for nervous lesions are seldom met with in the Service, hence any papers or reports dealing with operations on the nervous system are very rarely seen in our Journal. A brief paper, embodying the cases I have operated upon, may recall the chief characteristics and important features of nerve surgery.

The main operations performed on the cerebrospinal nerves are :—

(1) Neurolysis, or loosening of nerves; (2) neurorrhaphy, or nerve suture; (3) nerve anastomosis, or nerve grafting; (4) neurectomy, or nerve excision; (5) neurectasy, or nerve stretching.

I.—Neurolysis, or Loosening of Nerves.

This operation is necessary when a nerve-trunk is compressed by (*a*) adhesions, (*b*) callus.

The cases I operated on were :—

(1) *Ulnar Paralysis.*

Two years ago, on November 12, 1909, Gunner J. R.'s left forearm was run over by the wheel of a gun-carriage. The contused muscles suppurated, and several incisions were made on the anterior aspect of the forearm. Since then the patient has suffered from weakness in his left forearm and hand, accompanied by wasting of the interossei muscles, thenar, and hypothenar eminences. The hand was blue, clammy, and sweated profusely; there was a decided tendency to *main en griffe*.

Operation.—An incision 4 in. in length was made over the course of the ulnar nerve. The nerve was defined low down, and dissected free from a mass of adhesions, which bound the muscles together. The cicatricial tissue was removed, and the fleshy bellies of the flexor carpi ulnaris and flexor sublimis digitorum were sutured together with catgut over the nerve.

The following after-treatment was commenced when the stitches were removed on the tenth day: (1) Massage, (2) electricity, (3) active movement. The power in the left forearm and hand was greatly improved.

(2) *Brachial Paralysis.*

Private F., The King's Regiment, was admitted to the Station Hospital, Lahore Cant., on October 23, 1911, suffering from a self-inflicted bullet wound of the left side of the chest. The entrance wound was circular, $\frac{3}{4}$ in. in diameter, and was situated over the third rib in the left mammary line. The exit wound was just

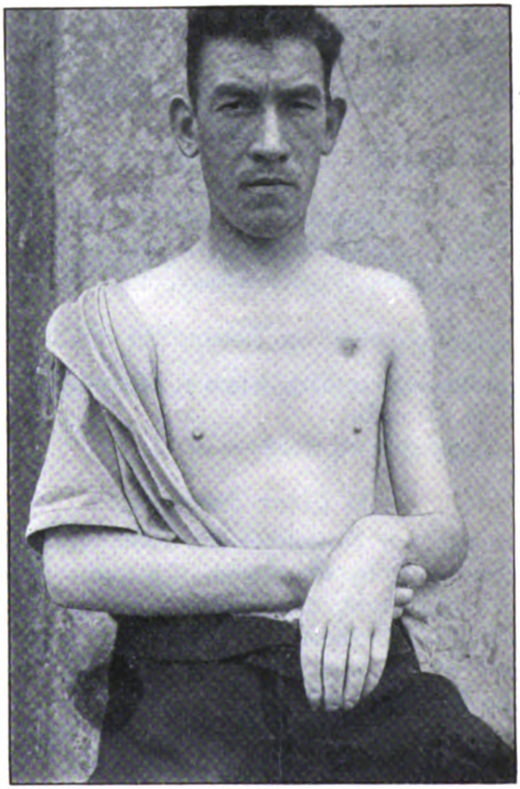


Fig. 1.—Bullet wound entrance.

external to the axillary border and $1\frac{1}{2}$ in. below the spine of the scapula. The bullet had not pierced the pleural cavity. The patient had been treated for six days in the Section Hospital, Fort Lahore, prior to his admission to the Station Hospital. Both wounds were suppurating, and there was complete sensory and motor paralysis of the left arm. The wounds were enlarged to allow of free drainage; and he was treated with injections of an autogenous staphylococcous vaccine.

On November 8, 1911, there was (1) great pain down the nerve-trunks of the arm; (2) rapid wasting of the muscles of the forearm and triceps: (3) the reaction of degeneration was present in the muscles; (4) slight return of sensation to touch over the skin area, corresponding to the distribution of the musculo-cutaneous nerve.

November 14, 1911.—Sensation has returned over: (1) The dorsal surface of thumb and first finger (median); (2) the area supplied by the supraclavicular and circumflex nerves.

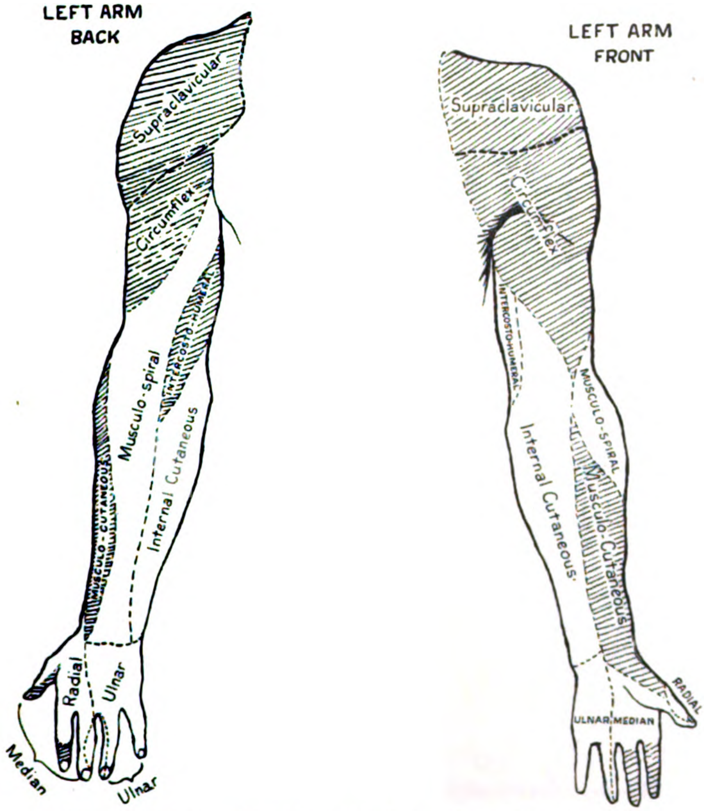


FIG. 2.—Diagram showing areas of sensation before operation.

December 6, 1911.—Both wounds have completely healed, and sensation has returned to the palmar aspect of the thumb, first and second fingers. The cicatricial track of the bullet can be felt in the axilla.

December 8, 1911.—The palm of the hand is hyperæsthetic.

The deltoid and triceps muscles are regaining their tone. There is slight power of flexion of the forearm, but no power of extension, pronation or supination. "Drop-wrist" is present, and the hand is blue, cold and clammy.

December 10, 1911.—Sensation has returned over the area supplied by the intercosto-humeral nerve.

January 25, 1912.—No further improvement has been noted.

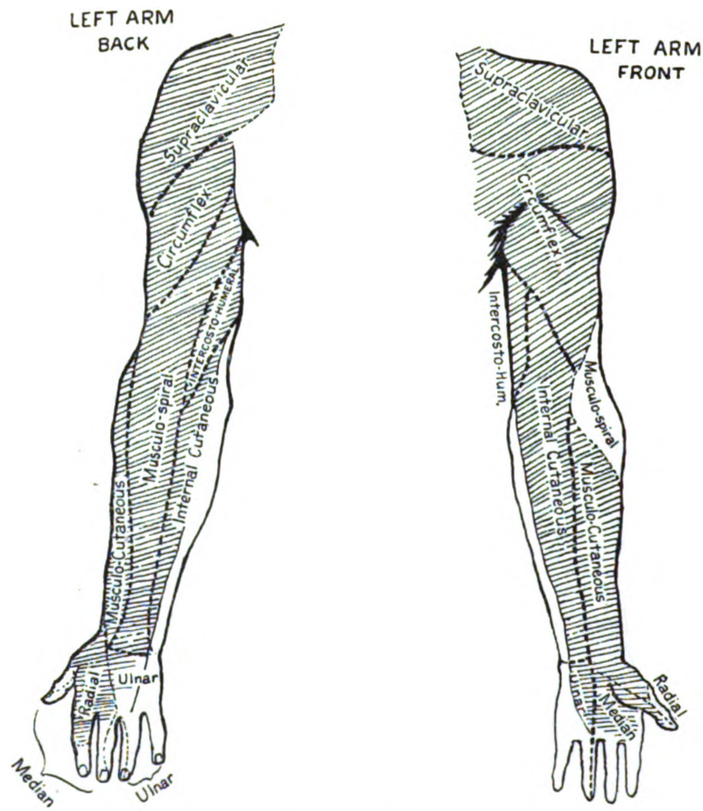


FIG. 3.—Diagram showing areas of sensation after operation.

January 26, 1912.—The patient's present condition is as follows: His general health is good. The pectoralis major muscle is bound down by adhesions, and a hard cicatricial mass can be felt in the axilla. The deltoid and biceps muscles are in a fair condition, but the triceps and extensor muscles are completely paralysed.

The extensor muscles are so wasted that the ulna and radius stand out prominently. The flexor muscles are very weak, and "drop-wrist" is marked. The skin of the hand is blue, cold and clammy. There are no other trophic changes.

Sensation has returned to the skin areas supplied by: (1) Supraclavicular, (2) circumflex, (3) musculo-cutaneous, (4) median supply to thumb, first and second fingers (hyperæsthesia of palm is noted), (5) intercosto-humeral.

There is no return of sensation over the skin areas supplied by: (1) Musculo-spiral, (2) internal cutaneous, (3) ulnar.

Operation.—(1) January 26, 1912: Axilla, chest and arm were shaved, and the operation area prepared with tincture of iodine. An incision was made through the base of the axilla, and the nerve-cords defined. Adhesions were cleared from the outer, and partially from the inner and posterior aspects of the brachial plexus. As the patient had been under chloroform for three hours I decided not to free the entire inner aspect of the plexus.

February 6, 1912.—The patient has made an excellent recovery from his operation; the stitches were removed, and he was allowed to get up.

February 18, 1912.—Sensation has returned to the whole arm except along the inner border of the ulna. The biceps and deltoid have recovered complete muscular tone. The patient is able to raise his arm above his head, flex, extend, supinate and pronate the forearm. There is still a slight degree of drop-wrist, and paralysis of the hand.

March 7, 1912.—As no further improvement has been noted, another operation was decided upon.

Operation.—(2) The arm was prepared in the same way, an incision being made from the anterior cicatrix of the bullet wound to the middle of the axilla. The pectoralis major muscle was divided, and the brachial plexus defined. A large mass of fibrous tissue surrounding the inner surface of the plexus was removed, and the plexus and large vessels were cleared up to the apex of the axilla. Portions of the median, ulnar and musculo-spinal nerves were undergoing fatty degeneration.

March 14, 1912.—The patient made a good recovery from the operation and the stitches were removed.

March 15, 1912.—The orderly medical officer was called to the patient at 10 p.m., and found him complaining of twitching and pain down the arm, spasm of neck muscles, and perspiring freely. I saw the case at 11 p.m. He was suffering from tetanus and

despite all treatment he died at 11 a.m. on the morning of March 17.

During the whole time this patient was in hospital the arm was kept bound in cotton wool, and expectant treatment, massage, electricity, active and passive movement, were carried out. This case is one of very great interest on account of the following points :—

(1) A bullet was fired at close quarters, and passed very near to, but did not grossly injure the brachial plexus, artery and vein.

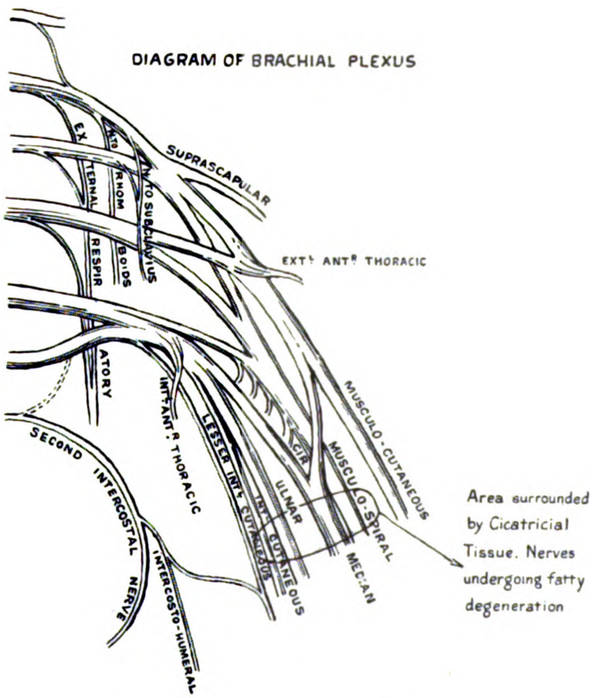


FIG. 4.—Diagram of brachial plexus.

(2) The primary paralysis was from concussion of the brachial plexus, and if the bullet wound had not become infected before the case was removed to the Station Hospital, the chances of recovery were good.

(3) The resulting cicatrix implicated the nerves and caused degeneration.

(4) The first operation resulted in a great improvement. The

whole plexus could not be cleared owing to the great shock caused by working for a considerable time in a large nerve area.

(5) Cultures made from the *interior* of the wound showed a slight growth of *Staphylococcus albus* and *aureus*, but no tetanus bacillus.

(3) *Musculo-spinal Paralysis.*

The result of an old fracture of the humerus. The fracture was due to direct violence, and the nerve was caught in the callus. There was complete "drop-wrist" with paralysis of the extensor and supinator muscles of the forearm and hand.

Operation.—The usual incision was made along the course of the musculo-spinal nerve, in the lower part of the upper arm. The nerve was exposed below, and followed up, the surrounding callus being gouged away.

The patient showed no improvement for six months, despite massage, electricity, active and passive movements. At the end of that time he commenced to improve, and in a month had complete and full use of his arm and hand.

II.—Neurorrhapy, or Nerve Suture.

Nerve suture may be: (1) Primary, (2) secondary.

Primary Suture.—Where there is an open wound, suture should be undertaken at once. This case was a typical example of this principle.

Private M. C., Connaught Rangers, was admitted to the Station Hospital, Lahore Cant., at 4 p.m., on January 17, 1911, suffering from a wound of the right wrist, caused by a fall on a broken bottle.

The patient was anæsthetized, and the following structures were found divided.

Muscles: (1) Flexor carpi ulnaris, (2) flexor sublimis digitorum, (3) palmaris longus. *Nerves:* (1) Median, (2) ulnar. *Arteries and veins:* Ulnar artery and its accompanying veins.

Operation.—A vertical incision at right angles to the wound was made as the flexor sublimis had retracted, and the bleeding points were tied. The divided tendons were sutured with catgut, but the divided nerves were sutured with fine cotton thread, threaded on a small round domestic sewing needle. The sutures were made to pierce the whole substance of the nerve, and were six in number. The subcutaneous tissue and skin were sutured separately.

FIG. 5.—Photograph of Pte. M. C. taken in April, 1912.

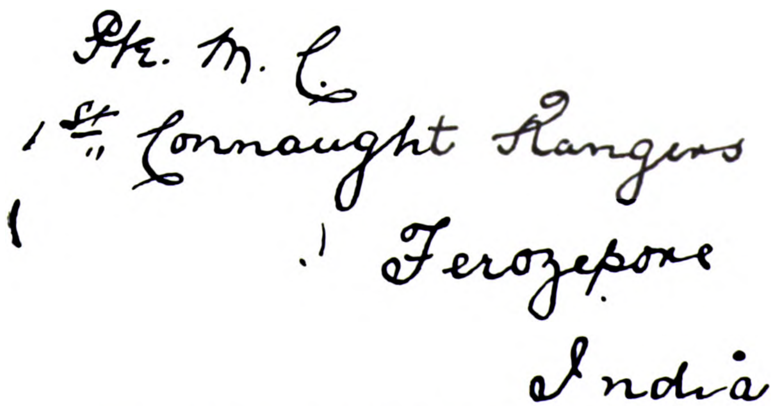


FIG. 6.—Specimen of Pte. M. C.'s handwriting, April, 1912.

January 25, 1911.—The wound was dressed, and the sutures removed. There was no return of sensation in the hand, which was kept rolled up in cotton wool. Massage, passive movement, and electricity were prescribed. There was wasting of the muscles, the skin was blue and was becoming glossy in appearance, but the patient can appreciate the sensation of touch in the palm of the hand, and halfway down the fingers.

March 14, 1911.—The sensation to touch has almost completely returned except along the palmar aspect of the little finger, and the dorsal aspect of the third and fourth digits, but the patient cannot distinguish between hot and cold.

April 14, 1911.—Sensation as above, and the patient can now open and close his hand.

After-history.—This patient, Private M. C., went to the Murree Hills with his regiment. The cicatrix had become adherent to the deep fascia, and limited the movements of his hand. This adhesion was freed by Major West, R.A.M.C., Surgical Specialist, 2nd Division. I saw him in April, 1912; he had complete and free movement of his wrist and hand; the only defect noticeable was that he could not appreciate the difference between heat and cold at the tips of the third and fourth digits.

Attached is a specimen of his handwriting and a photograph of the patient.

The special points of interest are the following:—

(1) The early return of sensation (on the twenty-fifth day); (2) the final complete return of power and sensation.

These facts show the very great importance of early and accurate suturing, when any nerve of importance is severed.

III.—Nerve Anastomosis, or Nerve Grafting.

This operation is usually performed when there is paralysis of a group of muscles, and there exists in the neighbourhood an intact motor or mixed nerve. Two cases operated on by me show the value of this operation. It was performed for: (1) Facial paralysis, (2) ulnar paralysis due to a neuroma of the ulnar nerve in the brachial plexus.

Case 1.—Gunner A. E. T., was admitted to the Station Hospital, Lahore Cant., with the following history. He had been operated on in March, 1910, in another station, for middle ear disease, and a radical mastoid operation had been performed. He subsequently suffered from facial paralysis. An attempt had been made to

implant the paralysed nerve on to the spinal accessory, but the facial nerve could not be discovered at the operation.

His condition on admission was as follows: His face was smooth, expressionless, and drawn towards the right. The left eyelids could not be approximated, and on attempting to do so the left eyeball rolled upwards and outwards. He was unable to whistle and his chief complaint was of the pain and irritation he suffered in the left eye when exposed to the sun.

Fig. 7. –Before.

Operation.—The head, face and neck were shaved and painted with tincture of iodine. An incision was made commencing behind the lobe of the left ear, and terminating halfway down the anterior border of the sternomastoid muscle. The old scar-tissue of the previous operation was dissected away, and the anterior border of the sternomastoid muscle defined. The posterior belly of the digastric muscle was next cleared. Running between these two muscles, the spinal accessory nerve was easily discovered and recognized. The parotid gland was divided transversely midway between the base and apex of the mastoid process, and the facial nerve dissected free and divided. It was greatly atrophied. The

main trunk of the spinal accessory was divided and turned up over the digastric muscle. Six fine silk sutures united the proximal end of the spinal accessory to the distal end of the facial. Two of these sutures were through and through, and four were perineural. The movements of the head and neck were limited by a poro-plastic splint until the stitches were removed on the twelfth day.

FIG. 8.—After.

The after-treatment consisted of massage and electricity to the face and neck.

Three months after the operation it was noticed that when the patient moved his left arm the left cheek twitched. One month later he could close his left eye by raising his left hand. On discharge from hospital, six months after the operation, he could *almost* close his left eye voluntarily, and by raising his arm

6 in. from his side could complete the act. There were several wrinkles round the left angle of his mouth. He was unable to whistle.

The left sternomastoid and trapezius muscle were wasted.

There are several very important points of interest in this case.

(1) There are only ninety-six reported cases.

(2) The patient had suffered from left facial paralysis from the date of his mastoid operation, a period of eighteen months.

(3) Movement of the left side of the face, associated with movement of the shoulder muscles, appeared within three months.

(4) He has now to learn to dissociate these movements.

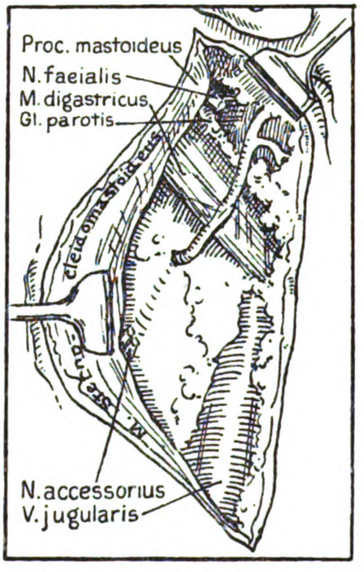


FIG. 9.—Diagram showing anastomisis of spinal accessory and facial nerves.

(5) The spinal accessory nerve was chosen, in preference to the hypoglossal nerve, as less inconvenience is caused to the patient by having the sternomastoid and trapezius thrown out of action than by having a paralysis of the face and tongue muscles combined. The mouth can be kept cleaner and there is less risk of infection spreading from the mouth up Stenson's duct to the parotid, and so interfering with the union of the sutured nerves.

(6) Both nerves were completely divided, and an end to end anastomosis was performed.

Case 2 (*Ulnar Paralysis*).—Private H. C., 1st S. Lanc. Regt.,

was admitted to the Station Hospital, Lahore Cant., March 3, 1911, suffering from pain and weakness of the right arm and hand. The pain was very severe, especially at night, and was of a peculiar shooting nature, commencing in the axilla and darting down to the wrist and hand, via the back of the elbow-joint.

Motor Symptoms.—The muscles of the forearm supplied by the ulnar nerve, the thenar and hypothenar eminences, and the interossei muscles of the hand, were all wasted. There was loss of adduction of the thumb, and abduction of the little finger. The condition known as *main en griffe* had formed.

Sensory Symptoms.—There was a complete loss of sensation over the little finger.

On Examination.—In the axilla a small hard swelling about the size of a hazel-nut could be felt in the line of the ulnar nerve. This swelling was movable on its transverse axis, and caused extreme pain down the course of the nerve.

Measurements of Right and Left Arm.—Right arm (upper) 9¼ in.; left arm, 10¼ in. Right forearm, 9½ in.; left forearm, 10½ in. Right wrist, 6½ in.; left wrist, 7½ in.

Circumference of right hand below thumb, 7 in.; left hand below thumb, 8¼ in.

Operation.—The axilla and surrounding parts were shaved, and the operation area prepared by painting it with tincture of iodine. An incision was made through the base of the axilla and the fascia divided. On drawing aside the axillary vein a neuroma 1¼ in. in length was observed, involving the whole thickness of the ulnar nerve. This tumour, although surrounded by a fibrous capsule, was not growing from the nerve-sheath, but involved the whole nerve-trunk. It was thickest in the centre, and tapered towards both extremities.

The neuroma was resected, and as the divided ends of the nerve could not be approximated, a lateral implantation of the distal end of the divided ulnar nerve was made into the median nerve. The fascia and skin were sutured. The wound healed by first intention.

The tumour on microscopical examination showed myxomatous degeneration. No nerve-cells or nerve-fibres were recognized.

Note.—The long history, the slow but progressive paralysis, the complete absence of nerve-fibres running through the tumour, are all points of great interest. I doubt whether lateral implantation of the distal end of a cut nerve into a sound nerve ever gives very good results, and in a similar case I should prefer bridging over the gap between the cut ends, either by a flap method or by joining

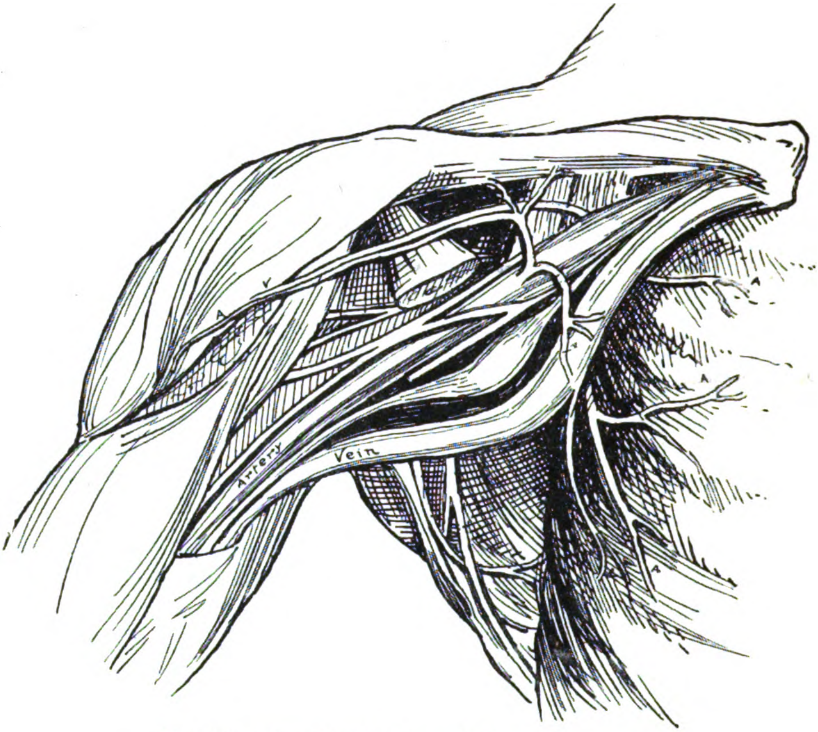


FIG. 10.—Dissection to show relations of neuroma.

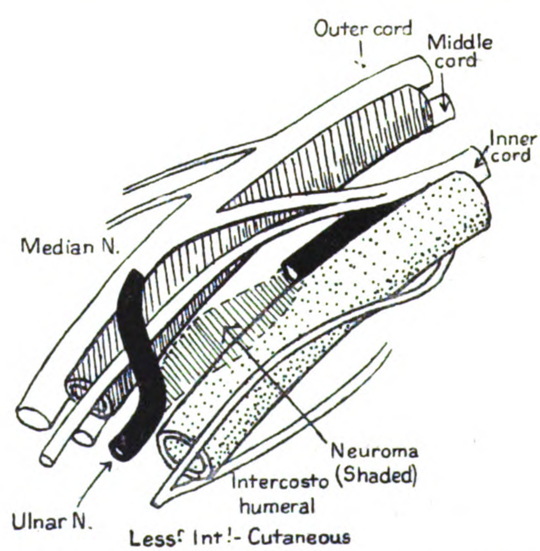


FIG. 11.—Diagram showing nerve suturing completed.

both ends to a portion of a large fresh nerve, obtained, if possible, from an amputated leg or arm. The reconstituted nerve would be protected from adhesions by surrounding it with a portion of a cutaneous vein obtained from the arm. This method is better than using Cargill's membrane.

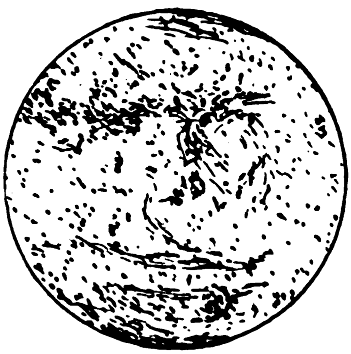


Fig. 12.—Microscopic section of tumour.

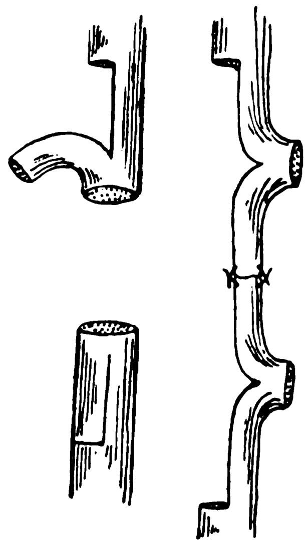


Fig. 13.—Suture of nerves by lateral anastomasis.

The difficulties, however, of working in the axilla are considerable. The excision of the tumour has probably removed the risk of sarcomatous degeneration.

V.—Neurectasy—or Nerve Stretching.

This operation is commonly performed for sciatica. Two cases under my care recently were as follows :—

Case 1.—The first was that of a native admitted to the Cantonment Hospital, Dalhousie. He had suffered from three bad attacks of sciatica, and had the usual symptoms and treatment. On admission to hospital the sciatic nerve was cut down upon and stretched, and the patient made a speedy recovery.

This operation can be performed in four minutes, and is well worth trying in obstinate cases.

Case 2.—Private M., The King's Regt., was admitted to the Station Hospital, Dalhousie, in July. He had suffered for the

previous five months from neuritis of the left sacral plexus, with wasting of the quadriceps muscle, and the muscles supplied by the anterior tibial nerve. Well-marked pes cavus had developed. The following operation was performed on him: (1) Stretching of the sciatic nerve; (2) lengthening of the Achillis tendon; (3) division of the plantar fascia.

Any other nerve operation on the anterior tibial nerve would have been useless, as there was not complete degeneration of the motor fibres and no degeneration at all of the sensory fibres.

Cranial Injury.

Case 1.—This case came under my care with the following history: Private H. H. was admitted from the line of march to the Station Hospital, Lahore Cant., on October 15, 1910. He had been kicked by a horse over the left eyebrow. The wound had required five silk sutures, and had suppurated slightly. He was semi-conscious, but easily roused, very irritable, and talked in a thick and drowsy manner. Light annoyed him. His pulse was slow and full, both knee-jerks being absent; there was no paralysis and no optic neuritis. He complained of severe pain down the back of his neck, left arm and leg.

December 19, 1910.—The left side was noticed to be completely anæsthetic. His convalescence was slow, and he suffered from severe headache and giddiness.

On January 9, 1911, he was invalided for concussion of the brain, and passed the Invaliding Board. The case had been treated in the usual way—ice-bag, calomel, &c.

January 28, 1911.—His condition when he came under my care was as follows: He complained of severe and persistent frontal headache. The area of the old injury over the left eyebrow was painful to the touch. His expression was vacuous, and there was paresis of the left arm and hand, and complete flaccid paralysis of the left leg. The left arm, left leg and a portion of his body were anæsthetic to touch, pain, heat and cold. The face was drawn over to the right side and he was unable to whistle.

Measures as follows: Right upper arm, 10½ in.; left upper arm, 10 in.; left forearm, 10 in.; right forearm, 11 in.; right thigh, 20 in.; left thigh, 19 in.; right calf, 13 in; left calf, 12½ in.

The patient's bowels were constipated, but there was no difficulty of micturition. The pupils were dilated and equal, but reacted to light and accommodation.

Ophthalmoscopic examination showed slight congestion of the veins round the right disc. His temperature was normal, pulse 56, slow and bounding, heart, lungs and urine were normal.

An examination was decided upon after consultation with five other members of the hospital staff.

January 29, 1912.—The entire head was shaved, and painted with tincture of iodine. A trephine opening 1 in. in diameter was made over the leg and arm centres on the right side of the brain. There was no pulsation of the brain, and on incising the dura mater a considerable quantity of slightly turbid serum escaped. A pair of sinus forceps was passed in the direction of the internal capsule, but no pus was discovered. The dura mater was sutured, but the disc of bone was not replaced.

After-history.—There was complete facial paralysis and slight slowness and slurring of the patient's speech for four days. This passed off gradually. On the sixth day his arm and leg were stronger, and he could bear a bright light. Stitches were removed on the twelfth day, and on the thirteenth day he was allowed to get up, as power had completely returned in his leg and arm. Ten days later, he was showing me how to train a polo pony.

I have had numerous letters from this patient, and he has kept very fit, and is at present acting as huntsman to a pack of hounds. This was a case of localized traumatic œdema. The points of interest are the following :—

(1) General irritability of the brain. (2) The late but slow and gradual increase of local symptoms, the flaccid paralysis and sensory symptoms pointing to a cortical lesion. (3) The rapidity of convalescence after the intracranial pressure had been relieved.

Case 2.—Driver F. W. (R.F.A.) was admitted to the Station Hospital, Lahore Cant., at 11.30 a.m, on September 11, 1911, suffering from an injury to his head. He had fallen from his horse and was taken to the Section Hospital at 8 a.m., where he was seen by Captain A. W. Byrne, R.A.M.C., who ordered his removal to the Station Hospital, and sent the following note: "Injury to skull, large swelling over the right parietal bone, fracture of left clavicle."

The patient was conscious, there was no paralysis, the breathing and the eyes were normal, pulse 76. He was seen at 11.30 a.m. by Captain W. W. Boyce, R.A.M.C. He was then semi-conscious, and there was complete paralysis of the left side of his body, his breathing was laboured, and his pupils were dilated, pulse slow and bounding, 58. Right side of body reacted to external stimulation.

I saw the case at 1.15 p.m. in consultation with these officers,

when the patient's condition was as follows: Complete unconsciousness, breathing stertorous, complete paralysis of the whole body.

I agreed with the diagnosis, right middle meningeal hæmorrhage. I was unable to draw off cerebrospinal fluid from the spinal canal, as the Hospital and Medical Store Depot, 3rd Division, did not have a spinal syringe in stock.

Operation.—This was commenced at 2.30 p.m., and the right side of the skull was trephined over Kronlein's anterior point—viz., a point $3\frac{1}{2}$ cm. behind the external angular process of the frontal bone, on a line drawn horizontally backwards from the supra-orbital margin. The artery was found unruptured in the middle of the exposed dura mater. The dura was incised, and the brain and lateral ventricles explored. No abnormality was discovered, the scalp wound was closed, and the patient was returned to the ward, where he died a few hours later.

Post-mortem examination showed that the brain substance was normal, but the fourth ventricle was very markedly dilated, and full of cerebro-spinal fluid.

The diagnosis of middle meningeal hæmorrhage was pardonable, as it was made from the observation of symptoms which agreed with a perfect textbook description of that condition.

Cases of acute dilatation of the fourth ventricle are very rare, and therefore worth recording.

It is important to remember that nerve cases, more than any other surgical conditions, require prolonged patience in carrying out the after-treatment, because signs of recovery and benefit are slow in appearing. No tissue in the body resents rough usage more strongly than does the nervous system. Tearing or coarse dissection, cutting with blunt and heavy knives and scissors, suturing with coarse needles and suture materials, inaccurate apposition, all these tell against a good result. Suture material and suitable instruments are not always available, but the Service eye case of instruments has been found of inestimable value.

I wish to express my very best thanks to Lieutenant-Colonel E. M. Hassard, Captain W. E. C. Lunn, and to my brother officers in the Station Hospital for their assistance.

A CASE OF CHOLERAIC DIARRHŒA CAUSED BY AN ORGANISM OF THE *BACILLUS PROTEUS* GROUP.

By Captain R. G. ARCHIBALD.
Royal Army Medical Corps.

THE clinical history of the case was as follows :—

The patient, a Greek labourer, was admitted one morning to Khartoum North Dispensary in a collapsed condition, suffering from abdominal cramps, vomiting and diarrhœa. The previous night he had partaken of a meal obtained at a native kitchen, and, up till within an hour of admission to the dispensary, was in apparently good health.

When seen by the medical officer in charge of the dispensary, the patient's symptoms simulated those of Asiatic cholera and the case was reported as such to the Medical Officer of Health. Peripheral blood-films were asked for and examination of them showed that malaria parasites were not present. A specimen of the patient's stools was also sent to the Wellcome Laboratories for a bacteriological examination.

The stools were greyish in colour, very offensive in odour, acholic, of a watery consistence and contained large flakes of mucus with but little fæculent material. Macroscopically they resembled closely "the rice-water stools" of Asiatic cholera.

Hanging-drop preparations of the stools showed the presence of epithelial flakes and large numbers of short motile bacilli. Neither vibrios nor intestinal parasites were present. Stained preparations showed practically nothing but the presence of short bacilli.

The usual technique of inoculating and incubating peptone flasks for the purpose of encouraging the growth of cholera vibrios was carried out. The inoculated flasks were carefully examined for evidence of cholera vibrios, but with negative results. They contained almost a pure culture of short, motile bacilli. It was noted, too, that a very penetrating and offensive odour was emitted from the inoculated flasks.

Samples of the stools were also suitably diluted and inoculated into MacConkey's bile salt broth tubes and after these had been incubated for twenty-four hours sub-cultures were made on Drigalski-Conradi media. Other portions of the stools were diluted and plated out directly on Drigalski-Conradi media. All the plates were examined at the end of forty-eight hours' incubation at 37° C. and found to contain a pure culture of large, bluish, globular colonies of a very viscid consistence. By transmitted light, each colony showed a pink centre.

A very heavy and penetrating odour emanated from the plates,

extremely suggestive of the odour given off by organisms of the *B. proteus fluorescens* type. At the end of seventy-two hours many of the colonies had coalesced and produced a characteristic, greenish-yellow fluorescence in the Drigalski-Conradi media.

Colonies were picked off and inoculated into broth, and after suitable incubation subcultures were made on agar slopes; colonies were also subcultured from agar into the various sugar media.

The broth culture was examined at the end of eighteen hours' incubation and found to contain a short, motile bacillus which was Gram negative and which stained readily with the usual aniline dyes. Its average length and breadth was 2·4 μ by 0·5 μ. The shorter forms measured 1·3 μ and resembled cocco-bacilli. Slight turbidity was produced in broth. On agar plates, the colonies were circular and of a greyish-yellow colour with a granular centre and opaque margin. On agar slopes, a greyish-yellow viscid growth was produced. The bacillus was an indol producer, the reaction being definitely obtained in an hour by the paradimethylbenzaldehyde test recommended by Marshall [1]. Owing to the prevailing climatic conditions, it was not possible to use gelatin as a culture medium.

A positive Voges-Proskauer reaction [2] was obtained in glucose peptone.

Acid and gas were produced in glucose, mannite, lævulose, maltose, galactose and dextrin, whereas no change occurred in lactose, cane sugar, dulcite, adonite, inulin and raffinose. Acid, but no clot, was produced in litmus milk; but, three days later, this medium became alkaline and permanently remained so. Blood serum was not liquefied.

On potato, a creamy, viscid growth was apparent in forty-eight hours. The bacillus was a facultative anaerobe, non-acid fast and non-spore forming; it stained readily with acid and basic dyes.

Pathogenicity.—A guinea-pig was injected intraperitoneally with 2 c.c. of a young broth culture of this bacillus. Four hours afterwards this animal died with a well-marked and severe peritonitis, and intense hyperæmia of the liver and spleen. The bacillus was isolated in pure culture from the heart's blood and spleen. Subcutaneous injection of 0·5 c.c. of a broth culture produced no ill-effects in a guinea-pig.

Some experiments were then carried out to ascertain whether guinea-pigs would develop symptoms of enteritis when fed with broth cultures of this bacillus. Apart, however, from causing a rise in temperature, no ill-effects were observed. In one experiment opium was given *per os* to a guinea-pig, so as to inhibit its intestinal peristaltic movements, and it was then fed with a young broth

culture. As the animal's health was apparently unimpaired at the end of a week, it was chloroformed. The small intestine in its lower part was hyperæmic, and the spleen was congested. The bacillus was isolated in pure culture from the spleen. Similar feeding experiments were carried out on a *Cercopithecus sebæus* monkey, but unfortunately the animal succumbed two days afterwards from pneumonia.

The pathogenic properties of this bacillus were also tested on a rabbit. Intraperitoneal inoculation with 0·2 c.c. of a broth culture caused death in twelve hours; the peritoneum, spleen and liver showing intense congestion. Subcutaneous injection of 1 c.c. of a broth culture produced no untoward symptoms, and feeding experiments *per os* gave the same results as in the guinea-pig.

Several agglutination tests with the bacillus were carried out with the sera of the animals used in the feeding experiments. The highest agglutination reached was a dilution of 1 in 40.

The patient's serum had no specific agglutinins either for this bacillus or for any of the *Bacillus typhosus* and *coli* group.

In all probability, the absence of a systemic infection of the patient would account for a deficiency in specific agglutinins; unfortunately, blood cultures were not carried out to prove the presence or absence of a septicæmia.

After frequent subcultures on agar, it was found that the virulence of this bacillus was somewhat attenuated. Its cultural reactions were tested again in the various sugars, and at the end of a month these reactions had in no way differed from the original ones carried out.

The further clinical history of the patient was as follows:—

After admission to hospital, he remained in a very critical and collapsed state for a period of twelve hours, but eventually responded to the potassium permanganate treatment recommended by Rogers [3] in cases of cholera.

For the sake of convenience a table of the cultural reactions of this bacillus is appended.

Glucose	Mannite	Lævulose	Maltose	Galactose	Dextrine	Lactose	Cane sugar	Dulcite	Adonite	Inulin	Raffinose	Litmus milk	Indol	Voges proskauer
+	+	+	+	+	+	–	–	–	–	–	–	A. Alk.	+	+

+ = Acid and gas. A. = Acid.
– = No acid and no gas. Alk. = Alkaline.

Conclusions.

If reference be made to the above table, it is apparent that the organism described possesses different cultural reactions from many of the pathogenic intestinal organisms that have been isolated from human excreta. It does not conform in all cultural reactions to any of the intestinal organisms mentioned in a very complete list in a recent paper by Castellani [4]. During the last four years the writer has had many opportunities of working out the various intestinal bacteria found in man and animals in the Sudan, and this organism has never previously been met with.

The clinical picture of the patient certainly indicated an intestinal infection with either the cholera vibrio or with an organism of the food-poisoning group. Bacteriological examination excluded the former, and cultural reactions and serum agglutination tests proved that the bacillus isolated did not correspond to those of the *B. Gaertner* or *B. paratyphosus* groups.

The fact that it produced a positive Voges-Proskauer reaction would, according to MacConkey [5], place it in either the *B. lactis aerogenes* or the *B. cloacæ* group.

Orr [6], however, in his work on milk, states that the organisms of the *B. proteus* group frequently give a positive Voges-Proskauer reaction. The writer is inclined to assign this bacillus to a position in the *B. proteus* group. Its chromogenic characters in certain media and its power of producing such an offensive odour during its growth, rather favour this view. The fluorescent properties rather resembled those of *B. proteus fluorescens*. Unlike most of the members of this group, this bacillus showed no tendency to grow in the form of filaments.

The proteus type of micro-organism was first isolated by Hauser [7], who considered it as the chief one concerned in the process of putrefaction. Since then, it has been studied by many observers.

Glenn [8] has worked at the cultural reactions of some of the proteus group. His observations, however, are chiefly confined to a study of the acid and gas-producing powers in sugar media and to the ferments produced.

Schnitzer [9] isolated a member of the proteus group from a case of cystitis, and Flexner [10] and Reed [11] have obtained a proteus organism in cases of peritonitis and pneumonia.

Booker [12], in his elaborate work on cholera infantum, came to the conclusion that *B. proteus vulgaris* played an important part in the etiology of that disease.

Metchnikoff [13] found *B. proteus* very commonly in the stools of children suffering from diarrhœa.

At the Bombay Medical Congress, Macy [14] read a useful paper on tropical diarrhœa, and stated that under certain predisposing conditions many of the proteus group of organisms might excite violent intestinal symptoms.

Recently, Cantu [15] has made an extensive investigation into the distribution of *B. proteus* in nature, and has noted its constant presence in vegetable products which are in direct contact with soil. According to this observer, the summer season appeared to favour its growth, a fact borne out by Metchnikoff, who found *B. proteus* frequently in the stools of adults during the late summer months. Metchnikoff considered that flies acted as the transmitting agents in infecting food, especially cheese and grapes.

Bernstein [16] found that by the use of boric acid to the extent of 0·3 per cent (20 grm. to the pound) a selective inhibitory effect was produced on all organisms of the *B. proteus* group. Advantage might therefore be taken of this as a prophylactic measure to be adopted in epidemic gastro-enteritis caused by organisms of this group.

Sufficient references have been given to show that the *B. proteus* group justifies a certain claim in being considered pathogenic to man, a claim which the writer feels has not aroused sufficient attention from bacteriologists, particularly in tropical countries.

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THE PHLEBOTOMUS FLIES OF THE MALTESE ISLANDS.

By Captain P. J. Marett.
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The phlebotomus, a psychodida, commonly misnamed the sand-fly, is to be found in many parts of the tropical and sub-tropical world. It is a well-known pest, but is frequently confounded with the true sand-fly, a simulium. These two families of blood-sucking insects have quite different life-histories, the simulium passing its preliminary stages in water, the phlebotomus its early life in damp organic detritus.

It is all the more confusing that the short fever due to the phlebotomus should be known as sand-fly fever.

As regards the different species of the genus *Phlebotomus* found in Malta, these have been worked out by Professor Newstead, of the Liverpool School of Tropical Medicine.

More work requires to be done in this direction, as it is certain that in Gozo other species exist, both among the large varieties and among the small. This aspect of the question was not studied, time being the determining factor. One variety, however, will be mentioned here; it very much resembles *P. papatasii* in size, and is very similar to, if not identical with, the *P. papatasii* of Austria. In this species the third segment of the antennæ in both sexes is only one-third longer than the fourth segment; and in the male, the terminal segment of the superior clasper is longer than the inferior clasper. I am indebted to Professor Doerr for four specimens of papataci from Mostar. They are labelled *P. papatasii*, but they differ from the Malta species of that name, in the above-mentioned essential points. There is no doubt that these two varieties, called *P. papatasii*, are different, and it is probable that a difference in the species of fly accounts for the difference in the severity of the Malta and of the Austrian sand-fly fever.

The Life-history.

Breeding Haunts.—The breeding grounds mentioned in my preliminary report (1910) were rubble walls, embankments, caves, bastions, &c. To these must be added a new breeding place which was found in Gozo. The married quarters in Gozo suffered severely from flies. Stones from the surrounding ground had been collected together, and had been piled up at the back of the quarters; this

heap came under suspicion and was removed, when the ground ventilators were found to be a refuge and probable breeding place.

The number of specimens of larvæ and pupæ found last year was small in proportion to the number found this year. During the summer of 1910 most of the work was carried out on rubble walls in Malta. This year (1911) a cave in Gozo, which was previously mentioned, was searched. The conditions in this cave were identical with those found in walls—*i.e.*, darkness, dampness, and food supply were the same; there was also the important factor that the place was undisturbed. Here, on more than one occasion, two pupæ have been found on one stone; and once as many as six specimens — larvæ, pupæ, and cases—were found within fifteen minutes in a small area. There is, therefore, no reason to retract or substantially alter any of the statements made previously as to the breeding places of these flies.

Habitat of the Different Species.—*P. papatasii* breeds out in caves and in embankments. These embankments are made by the deposition of rocks and stones, which allows of miniature caves existing in their depths communicating freely with the exterior; besides this, in many of the embankments to the fortification walls, there exist disused chambers which have been partially filled in with stones and rubbish.

P. perniciosus and *P. minutus* breed chiefly in the ordinary rubble walls and in the bastions; here the communications with the exterior are much smaller, allowing free entrance to the smaller varieties of the fly. These two species appear also to breed in the ground ventilators.

Length of Life.—Nothing more can be said of the time required for the development of the egg to the imago. The full time required for the various instars is as follows :—

Life of Egg.—In the hot weather these hatch out in from six to nine days. In cold weather they take a longer time, but as a rule, in moist test-tubes, if they have not hatched at the end of fourteen days, they become covered with moulds. In tubes which are kept somewhat dry, eggs have hatched out twenty days after being laid. No observations have been made with eggs in nature, as they are too small to be found.

The length of life of the larvæ is about eight weeks in the summer. When the temperature is low, or when there is an excess of moisture, the larvæ assume a resting stage, in which they are very feeble. In all probability they hibernate in this stage.

The length of life of the pupa is from eleven to sixteen days.

The total duration of these three stages, therefore, works out at about three months. This corresponds with the incidence of flies in nature. Flies appear and increase rapidly in numbers from the end of May and during June. These flies are probably from the last year's larvæ; they diminish in numbers during July and the beginning of August, and again become numerous from the latter half of August, till November when they disappear.

The Length of Life of the Fly.—This has been estimated in two ways. In the first, pupæ, adhering to their stones, were put up in earthern dishes, covered over with chiffon and kept in a cave. When the pupa hatched out, the fly was caught in a test tube, prepared with moist detritus, a mate being introduced into the test-tube.

Of pupæ, only four were thus treated. Copulation was not observed in any instance, and great difficulty was experienced in getting the flies to feed. The best result was where the fly, a female, lived for ten days. She fed on the second, fifth and eighth days. On the tenth day, she was found dead, having laid about thirty eggs on the cotton-wool plug of the test-tube.

The shortest life was six days. The fly was a female; she was given a mate, but she refused to feed, although feeding was attempted every day. She died without eggs being found either in the test-tube or in her body, which had none of the appearances of pregnancy. The other two flies, one a male, died on the ninth day, the other, a female, on the seventh day. No eggs were obtained from this last fly, although she fed on one occasion.

The average life of these four flies is eight days.

The second series of experiments were carried out in September at Sir Ronald Ross's request, and to him I am indebted for the conclusions arrived at concerning the length of life of sand-flies.

Flies resting on the walls of a room were caught in the usual way, either in the hospital or in the officers' mess. On windy nights flies do not appear, but they come out simultaneously in large numbers on still nights. During September watch was kept every evening for flies, and when they appeared as many specimens as could be caught were obtained and immediately placed in cages. The cages were 2 ft. by 1 ft. by ¾ ft., the floor and back made of wood, the remaining sides having their frame-work covered over with chiffon. The flies were given the opportunity of feeding on fresh or moist detritus, a Petri dish containing it being put into the cage daily; both male and female flies were to be seen in this detritus. For the feeding of females a guinea-pig was used at

first; the animal was placed in a cardboard box, the open top being laced up with string, thus allowing the flies free access to it. Later, when this method failed the flies were fed every evening, at sunset, on human blood. During the day the cages were kept in a cave; at sunset they were removed to an ordinary room. Whilst the cages were being transferred they were invariably covered over to protect the flies from the wind and from the sun.

Experiment I.—Fifty-one flies were put up in a cage on the night of September 12, 1911. These were all caught in the officers' mess. The following table gives all the data:—

Date of death	Number died	Males		Females		Remarks
		P. minutus	*P. perniciosus*	*P. minutus*	*P. perniciosus*	
13.9.11	7	2	2	1	2	—
14.9.11	19	5	6	3	4	1 ♀ undetermined, half eaten by spider.
15.9.11	7	—	4	—	3	—
16.9.11	—	—	—	—	—	—
17.9.11	2	—	1	—	1	—
18.9.11	9	—	3	1	5	—
19.9.11	3	1	—	1	1	—
20.9.11	1	—	1	—	—	—
21.9.11	2	—	2	—	—	—
22.9.11	1	—	—	—	1	—

The longest period during which a fly lived in the cage was ten days. The flies were caught after a windy night, and it is probable that some at least were caught on the evening of their first appearance. From this experiment the average life of flies in the cage works out at 3·6 days.

Experiment II.—Fourteen flies were caught in hospital on the night of September 18. A strong wind had been blowing during the evenings since September 13, 1911.

Date of death	Number died	Males		Females		Remarks
		P. minutus	*P. perniciosus*	*P. minutus*	*P. perniciosus*	
19.9.11	5	—	—	2	3	Of these flies 4 had finished laying eggs and 1 was full of ripe eggs.
20.9.11	—	—	—	—	—	—
21.9.11	4	—	1	1	2	—
22.9.11	—	—	—	—	—	—
23.9.11	4	1	—	1	—	2 indistinguishable—half eaten.
24.9.11	1	—	—	—	1	—

The longest duration of life in the cage was six days. If some of the flies were hatched on September 13, 1911, and unable to leave their habitats owing to the windy weather, the longest possible life would work out at twelve days. The average life in the cage works out at three days.

Experiment III.—Flies put up in the cage on September 22, 1911. Wind blowing every evening since September 19, 1911. Calm, warm sirocco night. Flies caught in officers' mess.

Date of death	Number died	Males		Females		Remarks
		P. minutus	*P. perniciosus*	*P. minutus*	*P. perniciosus*	
23.9.11	1	—	—	—	1	—
24.9.11	17	5	8	1	2	1 ♀ half eaten.
25.9.11	12	2	6	—	2	2 male *P. papatasii.*
26.9.11	5	1	2	2	—	—
27.9.11	5	2	2	—	1	—
28.9.11	—	—	—	—	—	—
29.9.11	1	—	—	—	1	—

The longest duration of life in the cage was seven days. The possible life, counting from September 19, 1911, works out at eleven days. The average life in the cage works out at three days. It must be noted that in the above averages the day on which flies were put into the cage is not counted. If this day is counted, the averages work out at 4·6 days, 4 days, and 4 days for Experiments I, II, and III, respectively. General average, 4·2 days.

Experiment IV.—The flies were placed in the cage on September 27, 1911. A strong wind had been blowing since September 23, 1911. No flies died on the 28th or 29th. The last fly died on October 2. These flies were caught in the hospital; circumstances did not allow of a daily examination of the flies. The longest duration of life in the cage was six days. The longest possible life dating from September 23 works out at ten days. Taking the combined ages of all flies in both series the following result is obtained:—

Days after caging	1	2	3	4	5	6	7	8	9	10
Four flies bred from pupa	..	..	..	..	..	1	1	..	1	1
Experiment II, 51 flies caught	7	19	7	0	2	9	3	1	2	1
,, III, 14 ,,	5	0	4	0	4	1	0	0	0	0
,, IV, 41 ,,	1	17	12	5	5	0	1	0	0	0
Total flies caught 106	13	36	23	5	11	10	4	1	2	1
Multiplied by heading ..	13	72	69	20	55	60	28	8	18	10

= 353 total days.

$$\frac{\text{353 total days}}{\text{106 total flies}} = \text{3·335 days—average life in captivity of caged flies.}$$

Ten days is the maximum duration of life, and was observed in two out of 110 flies in captivity. Now the deaths on the second and third days of captivity are in excess of the theoretical mortality, which points to the fact that caging had a deleterious effect on the flies.

From the above results it may be stated that the "potential longevity," i.e., the maximum possible life, is certainly over ten days—possibly considerably over this period.

The average longevity (3·335 days) is for insects of all ages. This average longevity of insects in captivity is inferred to be only one half the average longevity (also called "viability") of insects studied from birth. Thus the true viability of sand-flies should be about $2 \times 3{\cdot}335$ days $= 6{\cdot}67$ days. Here the first day of capture has not been counted in. Where this day is counted, the average length of life of all flies works out at 4·2 days, and the true viability becomes $4{\cdot}2 \times 2 = 8{\cdot}4$ days. This figure agrees with that for the four flies bred from the pupa $\frac{1}{4}(6 + 7 + 9 + 10) = 8$ days, which, of course, is based on a very few observations.

The number of flies under observation was possibly hardly sufficient, but the experiments extended over a month. In the work carried out on the length of life of the fly in 1910, the average length of life was given as "about ten days."

The question of length of life is intimately mixed up with the epidemiology of the disease. The longer the life of the transmitter, the greater the damage done by each individual fly, and therefore by the great mass of flies.

It has been worked out by Professor Doerr and by Lieutenant-Colonel C. Birt, R.A.M.C., that the fly is only infectious for seven days after having fed on an infected patient, so that a fly infectious on the seventh day of life on an average, probably only lives four or five days during which it is a carrier of disease.

In time, it may be possible to prove that a definite relationship exists between the length of the duration of a disease and the length of life of an insect which is the host or carrier, so that where a disease is one with a long incubation period, and a long duration, it will be necessary to search for an equally long-lived transmitter. The reason for this is that the germ of the disease must go through a correspondingly long cycle in its host, whether that host be a human being or the transmitter of disease to the human subject.

Incidence of the various Species.—This depends greatly on locality. Where there are caves and embankments, *P. papatasii* are numerous. *P. perniciosus* and *P. minutus* are to be found

wherever the flies are, but especially where there are bastions and rubble walls. The two latter varieties appear to exist in about equal numbers. *P. papatasii* are fewer in numbers than the above, while *P. nigerrimus* is scarce.

Habits of Flies.—On warm, still sirocco nights from June to October, flies are to be found. They appear at sunset, and if they have been kept in their breeding haunts for a day or so by the wind, their biting is far more noticeable. When a wind is blowing at night they do not appear till it drops. At daybreak they disappear, and if a wall be then watched they may be seen entering it.

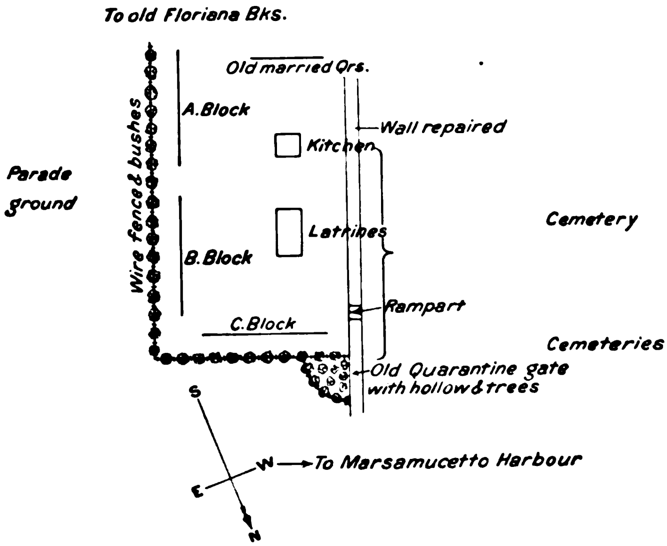
Effect of Wind.—When flies in a cage are exposed to a breeze, they cling to the chiffon, and their wings become twisted. On this account they are unable to withstand any wind. During windy periods the flies can be seen in the depths of caves. Their sensibility to moving air appears marked, for as soon as a plug is removed from a test-tube the fly will escape.

Effect of Light.—Daylight is inimical, and direct sunlight is injurious to the sand-fly. Artificial light, however, attracts them. This is not noticed where electric light is used, but in barracks lit by oil lamps this is seen in a marked manner, by the flies adhering to the lamps. If some white substance, paper or cloth, be spread beneath a lamp, it will be found to be covered with the bodies of flies which have been burnt during the course of the evening.

Distance of Flight.—This question, owing to the size of the fly, to its habit of appearing at night, and to the close proximity of breeding places, is extremely hard to settle. This year, however, with a knowledge of the different species, it has been possible to get a little nearer to a solution. Fort Chambray has its barrack block placed on a plateau, well exposed to any available wind, and at a distance of forty to fifty yards from the nearest fortification walls. Here the men did not suffer from the bites of sand-flies. On the other hand, the married quarters, placed close to the bastion wall, at a distance of fifteen to twenty yards, were infested with flies. From this it would appear that the estimated range of flight might be possibly reduced, and may be taken to be less than that of the mosquito. The height of flight cannot be determined with accuracy, but undoubtedly the upper floors of a house are much freer from the fly, except where the building is built on a bastion, or where there are rubble walls erected against the building.

Food.—Both male and female flies have a habit of burying the mouth parts in moist detritus. The females alone are blood-suckers ; in no instance has a male fly been found to contain blood. The females will suck blood from any warm-blooded animal, and have been caught issuing from a wall with fresh blood in the stomach, probably from biting a rat in the wall.

Prophylactic Measures. Suggested Measures for the Prevention of Breeding.—Last year, 1910, it was suggested, if all walls in close proximity to barrack rooms were properly faced, so as to prevent communication with the interior, that the number of flies would be lessened. This was carried out on an experimental scale in



Plan of New Portion of Floriana Barracks occupied in 1903.

a small area of the Floriana Barracks, which have always been notorious for the large number of admissions to hospital for sand-fly fever. His Excellency the Governor and Commander-in-Chief, sanctioned the repair of this rampart by the Royal Engineers. The work was carried out so as to be completed before the beginning of the sand-fly season. The plan shows the area as it was in 1907. The rampart is some 10 to 12 ft. thick, and on the side of the barracks is about 5 ft. high, whilst on the opposite side there is a drop of about 40 ft. The wall for a distance of about 50 to 60 yds. was cleared of vegetation, and all cracks and holes were

filled in, special care being taken of that portion of the wall at ground level on the barrack-side, where the ground was found to be hollow in several places, and here the earth and stones were mixed with cement and replaced, so as to allow as little communication as possible with the interior of the wall. On examination of the work after it had been completed, it was found that ants had worked their way out in several places, so that these have to be reckoned with. The barracks were visited on several occasions at night, sometimes rooms were searched for flies, but more often an hour or so was spent sitting in the open, under the wall by the trees. In the early part of the season, the barracks were remarkably free from sand-flies. Later, towards the end of the sand-fly season, it was reported that there were some flies. The results of the work seem to be good, as the admissions to hospital for the summer (1911) for sand-fly fever for a recently-arrived regiment were only two. Cases of fever were occasionally detained, I was informed, but there is little doubt that this improvement, especially amongst new arrivals, was due in a great measure to the work that has been carried out. The appearance of flies towards the end of the season was probably due to ants and wood-lice penetrating the walls, &c. To counteract this, once the walls have been repaired, it would be an easy matter for the walls at ground level to be kept under supervision by regimental labour.

This increase of flies may also have been due to the ground ventilators acting as breeding places. These should be protected by coverings of fine-meshed wire gauze.

The wholesale repairing of bastions is an enormous undertaking, but the repair or removal of walls within 15 to 20 yds. of sleeping rooms could be accomplished.

Prophylactic measures can be divided under the following headings:—

(1) Work carried out by engineers, (2) by sanitary squads, (3) by individuals.

(1) Work by engineers.

(*a*) Repair of all walls within 20 yds. of inhabited buildings.

(*b*) Removal of useless walls and heaps of stones, &c.

(*c*) Levelling of portions of bastions to allow of freer air circulation.

(*d*) Where large quantities of stone are massed together covering them with a good layer of soil.

(*e*) Making wire fences instead of walls for boundaries, or, if walls have to be used, to build them of solid masonry; but this would be very costly.

(*f*) Putting fine meshed wire gauze over ventilators.

(2) Work carried out by sanitary squads and regimental labour.

(*a*) Removing all rank vegetation and refuse from bases of walls and from all holes; these should be filled in and levelled.

(*b*) Burning all weeds on rough-made ground round barracks so as to allow of holes in the ground being seen and filled in. Where stones crop up, these should be beaten in and covered over with earth. Gardens on such made ground should be encouraged; the earth and the watering that is essential to their maintenance, and the roots of plants, will assist in keeping the surface unbroken. Large embankments should be planted over with native aromatic plants, such as thyme and pennyroyal, and kept well earthed.

(*c*) Filling in and destroying all ant-holes and other channels made by insects, especially when in connexion with walls.

(*d*) Care of wire gauze to ground ventilators to see that these are kept in repair.

(3) Work carried out by individuals in barrack rooms.

(*a*) Windows to be kept open to allow of utmost circulation of air.

(*b*) Bed cots to be kept well away from walls.

(*c*) Kits to be taken down and removed from walls daily. Great coats and black kit-bags, especially when in a corner of a room, are a great harbour of refuge to the fly during daylight.

(*d*) Ointment to be provided for the use of men. If properly looked after and used according to directions, one ounce of ointment will easily last a man for the summer.

For those who can afford every luxury, mosquito curtains, sprayed over with formalin solution, and the use of an electric fan, would ensure undisturbed rest. Bedrooms at the top of a house are better than those on lower floors. All dwellings should be as much as possible in the open. Trees against a house only attract sand-flies, owing to the protection afforded to them against the wind. Vegetation *per se* does not appear to have any connexion whatever with the breeding places of the sand-fly.

SANITATION IN THE TERRITORIAL FORCE, WITH SPECIAL REFERENCE TO THE SANITARY COMPANIES.[1]

By Major E. C. FREEMAN.
Royal Army Medical Corps (Retired Pay).

A good deal has been written on Territorial Force sanitation, and now that the fifth training in camp is just over it seems a convenient moment to look round and see what sanitary gains we have made in these five years, and what steps remain to be taken.

Some interesting papers appeared lately on the subject in the *Transactions of the United Services Medical Society*, but the writers appeared somewhat overwhelmed by the details of ordinary camp sanitation, and seemed hardly to realize the larger issues involved; in fact the writer of the paper on the Sanitary Company scarcely justified the continued existence of that unit, as the work he outlined for it should all be done by other organizations.

New establishments have been laid down for the Territorial Force—such as Water Duty Detachments and Sanitary Companies —before they have had any practical existence in the Regular Army, and these must be considered as being still in the experimental stage.

First, to clear the ground, it may be said that although Territorial sanitation is still very far from perfect, it has made great strides since it began five years ago. It recently fell to the writer's lot to inspect three brigade camps in three different localities, and in each destructors and grease traps were the rule, great trouble was taken to get rid of sullage water, glaring mistakes were few, and the general standard of neatness and cleanliness was high, and this in spite of very unfavourable weather.

Yet the regimental sanitation is the weakest spot save one in the Territorial medical organization, and this for two reasons, the first being the paucity of regimental medical officers, and the second the absence of any sanitary squad. The paucity of regimental medical officers is due to the fact that they are penalized by being debarred from promotion above the rank of major, by the superior attractions of field ambulance work, and by the present uncertainty of professional prospects in civil life.

[1] Received for publication on August 30, 1912.

Many regimental medical officers join without any knowledge of camp sanitation and its importance, and do not get opportunity for acquiring the knowledge afterwards. This can be remedied by inviting them to work in the field ambulance as much as possible during brigade camps, when they can learn both camp sanitation and stretcher drill. In fact it would be a most excellent thing if every medical officer, before joining a regiment, did his first year's training with the nearest field ambulance. He would thus get a grasp of the subject which would stand him in good stead afterwards.

The sanitary squad as an organized body does not exist in the Territorial Force; men will not join for such work, so it has to be done by the pioneers, fatigue parties and defaulters. To get over this difficulty it becomes most important that the quartermaster who supervises the work should be well grounded in sanitation, and it would be an obvious advantage if each unit were allowed a sanitation serjeant who ought to be a sanitary inspector, or at least hold a sanitary qualification. Some sanitary instruction to the regimental pioneers is also desirable. In this way a substitute for the sanitary squad may be found.

Next come the water duty squads, and, again, in the Territorial Force men will not enlist in any numbers for this duty, which involves unattractive work and camping with strangers. Moreover, their duties will be purely honorary, as no filter-carts are issued to the Territorial battalions in peace or war, and the training camps are invariably supplied with pipe water. These men, when obtainable—as they are trained in first aid—would be useful as sick attendants and sanitary orderlies to the medical officers of the regiments; so it would be better that they should be relegated to this work, and the name "water duties" dropped. At present in a Territorial battalion the medical officer has no one whatever to take charge of any detention hospital or any sick he may have, and the corporal and Royal Army Medical Corps orderlies would come in most usefully. For example, we must remember the youth of the Territorial soldiers and the consequent sore feet resulting after a march. Battalions last year provided fifty to sixty such cases daily, most of which might have been prevented by prophylactic treatment of boots, feet and socks.

It is also worthy of consideration that men solely employed on "water duties" would not come within the scope of the Geneva Convention, which they would do if employed in regimental hospital work. All men enlisted in the Territorial medical units wear

the Geneva badge and work under its protection; they look on it as a regimental badge, and would be unwilling to remove it to do "water duty."

When a regiment is with its brigade, a field ambulance is generally included in the force, and the officer commanding the field ambulance—as senior medical officer—advises the brigadier on sanitary matters, and sees that a uniform system of sanitation is carried out by all units in the camp. He also gives instruction by sending qualified detachments to units which require it, to assist in making incinerators, grease traps, &c., or has demonstrations given in the field ambulance camp. In this way the field ambulance has a very real and effective educational value in instructing the Territorial Force in sanitary matters. No other agency can do that work because the same field ambulance is usually associated with the same brigade, so that continuity of instruction is ensured. I do not think that a better or more practical mode of instruction could be devised, provided only that the officer commanding the field ambulance is a competent officer. At the present moment the importance of routine inspection of rations, coffee shop supplies and the like, is the point which seems least understood.

The specialist sanitary officer of the division, besides examining and reporting on all camp sites before they are accepted, and giving occasional lectures on hygiene, enters on his principal functions when the division is assembled in camp. Here he advises the A.D.M.S. on all sanitary matters, and takes charge of the general sanitation of the brigade camps.

It is probably desirable that the specialist sanitary officers should be equipped with the materials for simple bacteriological work and for water analysis, and be supplied with a trained orderly (who, in the East Anglian division would be readily obtained from Cambridge); but this is not allowed at present, and has not yet, I think, been asked for.

Of course, in the Territorials—as in the Regulars—the medical or sanitary officer is an advisor, and the technical responsibility lies with the officer commanding each unit; but Territorial commanders, having had less experience, are often less conscious of the importance of sanitation than Regular officers, hence the Territorial officer has often to assume somewhat of an executive function.

On the other hand, the A.D.M.S. is always informed of projected camps, and the site is always inspected beforehand. But brigadiers

very often omit to send in rough plans of the projected arrangements for their camps, and in this way mistakes are often made which are expensive to alter, and which might have been avoided if advice had been asked in the initial stage. There is still a very natural tendency to consider appearances too much and to put cookhouses, latrines, ablution benches and horse lines together in rear of the camp.

We now come to the new unit, the Sanitary Company, which is 100 strong, including five officers. One hopes that in time there will be one to each of the fourteen divisions—not as divisional troops, for reasons to be set forth later, but attached to a division in peace time, and becoming Corps troops on mobilization like the general hospitals.

If I have been able to demonstrate anything in this paper, it is that camp sanitation can be effectively taught and effectively carried out between the regiments and the field ambulances—with the assistance of the specialist sanitary officer of the division. If the Sanitary Company is to find its *raison d'être* simply in teaching camp sanitation it will be merely an expensive and wasteful luxury.

I, myself, believe that a Sanitary Company on mobilization would find its work on the lines of communication. It should relieve the overworked Royal Engineers of their medical work, which they cannot do properly without medical supervision, and relieve the Royal Army Medical Corps of much work which is essential, but which, being behind the fighting line, is neglected, often with the worst results. In this way I think a Sanitary Company has a great and useful future before it.

A Sanitary Company should be prepared to deal with :—

(1) Sanitary field engineering.
(2) Water supply on a large scale.
(3) Preservation and storage of food.
(4) Epidemics and infectious outbreaks.
(5) Disinfection on a large scale.
(6) Sanitary disposal of dead animals and men.

Field sanitary engineering includes, besides camp sanitation, a knowledge of the simpler forms of plumbing, drain-laying, culverts, water-pipes, and so forth.

Water supply, besides the knowledge of improvising access to water, of tube wells, pumps, &c., would imply sufficient knowledge to mend up and keep going a town water supply if not too badly damaged, and the methods of laying water on to a camp by pipes.

Preservation and storage of food means knowledge of the simpler

methods of preserving food from contamination and putrefaction, and the precautions to be observed as to dryness, coolness, and so on, when stacking tinned foods, cereals, &c.; one officer should be a competent analytical chemist, and the necessary equipment for analysis of food samples should be carried.

Epidemics and infectious outbreaks, if they are to be controlled, require careful bacteriological research from the outset, so the Sanitary Compnay must have at least one officer who is a competent bacteriologist, and a complete bacteriological outfit is necessary.

Disinfection on a large scale will often be required, and the company must be familiar with the various forms of portable disinfector, and all means of chemical disinfection, and methods of improvising apparatus.

Sanitary disposal of dead animals and men on the battlefield will engage the attention of the Sanitary Company in varying circumstances, and it must be prepared with the system best adapted to the occasion.

I should like to explain my meaning by a few supposititious cases, as concrete examples of work to be done—premising that, as reference is made only to Territorials, all allusion to embarkations and disembarkations (where sanitation is so much required) is left out.

Immediately after mobilization of the Territorial division the Sanitary Company is sent to assist in the preparation of the general hospital at "A." In this and all subsequent cases local labour is employed as required under the direction and supervision of the officer of the company.

A convalescent camp is to be established at "B" in connexion with the general hospital. A section of the company is sent; assisted by local labour, it lays on a water supply, improvises latrines, lays culverts to carry off sullage water, sets up a destructor, and reports to the D.D.M.S. Lines of Communication that the site is ready for the camp.

A hospital on the lines of communication is to be established at the town of "C." A section proceeds to take over the allotted buildings and to adapt them for the purpose required with regard to light, ventilation, and convenience, makes or enlarges kitchens and latrines, adapts the water supply, and reports the buildings as ready.

As large depots are to be prepared in the city of "D.," an officer and small party is despatched to advise the Officer Commanding A.S.C. as to the best plans and method of storage

of food, to examine samples, and to give an opinion as to whether certain tinned consignments are fit for issue.

The D.D.M.S. Lines of Communication hearing that enteric fever has broken out at "E.," an important post where a mixed force is stationed, despatches a section of the Sanitary Company. On arrival the cases are found to have been dealt with by the A.D.M.S., but the section proceeds to disinfect buildings, burn rubbish and excreta, put up new latrines, install water-boiling arrangements, while the officer confers with the local health authorities and takes any further steps considered necessary to make the place healthy, as it must be held by troops and cannot be abandoned. In connexion with the above several hundred blankets are sent to the Sanitary Company for thorough disinfection before re-issue.

The D.D.M.S. finding the lines of communication constantly increasing in length determines to establish a central bacteriological laboratory at "F.," to deal with specimens which are constantly sent in from the front, and also to distribute prophylactic vaccines. For this purpose the bacteriologist, with a serjeant and three men, is detached from the Sanitary Company.

The G.O.C. wires G.O.C. Lines of Communication that he has gained a battle in the neighbourhood of "G." and has left a detachment to clear up the battlefield, but the Sanitary Company is urgently required to supervise, as an outbreak of sickness is feared.

The above is the roughest sketch of the work the Sanitary Company might be called upon to do—and to do it much education is necessary. Mechanics, carpenters, plumbers, laboratory assistants, and so forth, are wanted for the rank and file; all N.C.O.'s should have a sanitary qualification, and if possible be sanitary inspectors in civil life; the officers must all be medical officers of health, some must hold specialist qualifications.

After thorough grounding in first aid and camp sanitation as a basis, the men should be allowed to specialize in their different departments, and pains should be taken to attach them in small parties to large water, sewage, municipal and destructor works, or to hospitals and large institutions, instead of always sending them to camp, so that they may get really practical knowledge of sanitation of all kinds. In this way a very valuable unit might be formed, but it cannot be repeated too often that in the war for which Territorials are organized buildings will be used wherever possible, and tents not at all—hence if men are taught "camp sanitation"

only, they will be "fish out of water" when the pinch comes and their services are required to deal with houses, towns, and villages.

It was said early in this paper that "the weakest spot save one was regimental sanitation." The weakest spot of all is Territorial sanitation in the clearing hospital, which is to be formed after mobilization by the Voluntary Aid Detachments. What will happen in these hospitals it is impossible to imagine from a sanitary standpoint. It is true that the sick are in them for a short time only, but they will pass through in quick succession, and delays are frequent in war, while the contagion of enteric is easily spread. It is impossible in ambulance classes to dwell on fæcal contamination from latrines, &c., and the precautions urgently needed in dealing with all excreta and safeguarding water supplies.

If a proposal made in the ROYAL ARMY MEDICAL CORPS JOURNAL by the writer in a former article could be entertained, and a R.A.M.C.T. nucleus for the clearing hospital, consisting of an officer and fifteen men, were attached to each existing general hospital cadre—something might be effected to remedy matters. Probably, as matters are at present, a nursing subdivision would have to be detailed in all cases to form the basis for the clearing hospitals, around which voluntary assistance might collect, but this unduly depletes the field ambulances.

Some of the proposals here put forward may seem revolutionary, but the writer is convinced that in the Territorial Force the time is ripe for a readjustment of work between the R.E. and the R.A.M.C., and that the justification for the continued existence and extension of the Sanitary Companies lies in the direction he has endeavoured to point out.

Finally, the temporary massing together of large numbers of sick and wounded in charge of civilians without sanitary training would seem certain to lead to the diffusion of infectious disease, unless some provision of trained staff is made in peace time.

United Services Medical Society.

THE TACTICAL EMPLOYMENT OF FIELD MEDICAL UNITS.

By Lieutenant-Colonel G. D. HUNTER, D.S.O.
Royal Army Medical Corps.

The tactical employment of Field Medical Units or "medical tactics" is a subject of great interest and importance, and demands the closest attention of all of us.

In a review of the work done during the training season at Aldershot, in 1912, it is remarked, "Although the work done by the medical units, both at the camp at Frith Hill, and during the Royal Army Medical Corps manœuvres, was most creditable to all concerned, it was clearly shown that more practice was required, both by medical units and medical officers themselves, at working with troops in the field, and thus assimilating the tactical knowledge necessary for the proper handling of their units during operations in war."

Medical tactics is a subject which in Continental armies, and more especially in the Austrian Army, excites much interest, and has been highly elaborated. In our own Army it is now exciting an equal interest, and its study must be encouraged in every way. Napoleon said, "That the perfect army would be that in which every officer knew what he ought to do in any situation in the field."

All officers of our Corps should not only study, but endeavour to familiarize themselves with the organization and complex machinery of an army in the field, and with the meaning of the various operations of war.

The medical service of a field army has for its main object the rapid clearance of sick and wounded from the fighting area to the line of evacuation to the general hospitals.

The success of medical tactics depends on the field medical units being distributed in such a manner over the area of operations, that the above object is attained with the least amount of discomfort to the wounded, and in the most rapid way. Such success adds greatly to the mobility and *moral* of the army.

This evening I propose to deal only with the tactical disposition of the field medical units of an infantry division, viz., the field

ambulances. These units are rightly allotted as divisional units, under the command of the A.D.M.S. of the division. The point is not infrequently raised, that their allotment as brigade units is preferable, but it appears undeniable that, under the present conditions of war, the divisional organization must be the most efficient one.

The Field Ambulance organization has not yet stood the test of war, and its use in the field has so far been confined to peace manœuvres. This combined unit, under one commanding officer, appears to be the ideal one, but, whether its present formation cannot be to some extent improved upon, is perhaps a subject worthy of serious reflection.

The disposal of these three units previous to and during battle depends primarily upon the A.D.M.S. of the division, and secondarily upon the officers commanding field ambulances; and upon their harmonious co-ordination will depend the success of the work in hand.

The action of the two forces which meet in battle are usually considered under two headings, "Attack" and "Defence." Under the term "Attack" we describe the action of that force which, having gained the initiative, assumes the offensive first. Under the term "Defence" is considered the action of that force which, having postponed the assumption of the offensive, awaits attack in the first instance. This does not imply that one force invariably attacks, and the other acts purely on the defensive. A commander may employ defensive or offensive action to suit his requirements, or perhaps strategical conditions may suddenly arise which permit a commander, acting on the defensive, to deliver a vigorous counter-attack.

When armies are in proximity, a battle is frequently brought about by the unpremeditated meeting of opposing forces; this is usually termed "an encounter battle." In these circumstances, the general strategical situation of the meeting forces will determine which assumes the offensive, and which the defensive. Other conditions may arise after battle, which influence our medical tactics, viz.: "pursuit" of a routed enemy, and "retreat."

The tactical disposition of the field medical units of a division must necessarily depend upon the nature of the action about to be fought, but mindful of the uncertainties of war one should be prepared at any time to modify one's plans to meet any sudden emergencies that may arise.

What are Medical Tactics? I would answer: The study of the

handling of medical units in the field in such a way, that the battle area is cleared of casualties in the quickest and most efficient manner—i.e., how to clear the field of wounded.

How are they to be learnt? By the close study of medical tactical problems. Officers are recommended to work out the tactical disposition of units on the map according to definite schemes of "attack" or "defence," and to attend conferences subsequently to discuss the various points raised; also to read military history and contemporary literature.

Essays, papers—such as this, I fear—are often a mere catalogue of generalities, the point of which resides in their application, that is, in understanding and practice. Real instruction can best be gained from the study and solution of concrete problems. It is the *application* of principles in fact that requires study and practice, not merely learning principles. All are not Heaven-born tacticians, and in war it will be the application of the principles learnt in peace that will lead to success of our medical tactics in battle.

The A.D.M.S. should always endeavour to be in intimate relation with the divisional commander and his staff, and keep himself well informed of the military situation generally and of the intention of the commander previous to an engagement. The success or non-success of his medical arrangements will depend on his grasp of the situation and his knowledge of the object the commander has in view.

His draft for insertion in divisional operation orders should include:—

(1) The allotment of field ambulances, sections or sub-divisions to brigades or columns as he thinks advisable, bearing in mind the necessity of keeping a good reserve in hand; the unexpected constantly happens, in fact, is more often the rule in war—and medical assistance may suddenly be required where least expected.

(2) The allocation of a divisional collecting station for slightly wounded—this should be inserted in divisional operation orders, when heavy fighting is anticipated.

(3) The road or roads by which ambulance wagons can clear wounded—it is very advisable to arrange this with the divisional staff if possible, it may save endless confusion and delay.

His scheme of medical arrangements and proposed disposition of the medical units will vary with the nature of the coming action. In operations of "Defence" the problem is usually an easy one, as the area in which casualties are likely to occur is to a certain extent definite and circumscribed, the ground occupied is previously

known, consequently the dispositions and arrangements for removal of casualties can be more deliberately made beforehand. In operations of "Attack" the problem is of a more complex nature, as one is to an extent venturing into the unknown, the ground to be occupied is possibly new, the frontage is usually wider and the attack may also include a wide flanking movement, which will involve a considerably extended area in which casualties may occur. In attack, the sites for dressing stations can rarely be settled beforehand, but must await the development of the action and the advance or otherwise of the attacking force. In an "Encounter Battle" even greater difficulties may arise, as the action (being often unpremeditated and sudden) may partake of an offensive or defensive nature, and the troops be generally engaged before any definite scheme can be settled upon. In such a case the medical units involved will usually have to act on their own initiative; arrangements with regard to the evacuation of casualties being made later according to circumstances.

The A.D.M.S., having settled upon his general plan of action in conjunction with divisional headquarters, is now able to issue his R.A.M.C. operation orders and instructions to units under his command. In issuing these orders he should be guided by the following principles :—

(1) A definite task should be assigned to each unit, the limits of frontage being specified as far as possible.

(2) The choice of the manner in which the task assigned to each unit is to be performed should be left to its commander.

Very precise directions are given in field service regulations as to framing operation orders, which it is hardly necessary for me to recapitulate, except the main fact that "an operation order should contain just what the recipient requires to know and nothing more."

The principal points to be dealt with are :—

The body of troops each unit will serve.

The times and order of march.

The area allotted to each unit, with actual limits of frontage, if possible.

Sites of dressing stations may be laid down in operations of "Defence" but rarely in those of "Attack."

The place to, and roads by, which field ambulances will evacuate their wounded (this may be the refilling point or otherwise).

Site of the divisional collecting station.

The place to which reports and messages for A.D.M.S. will be sent.

The A.D.M.S. should, when possible, reconnoitre the ground in company with the Os.C. field ambulances or their representatives, explain to them, as far as necessary, his general plan for the operations in hand, and satisfy himself that they understand their orders and the task allotted to each.

General Conduct of Operations in a Battle of Attack.

The principle of successful attack is the determination of the commander to press forward at all costs, and deliver the final assault under the most favourable conditions at the enemy's most vital point.

In attack, as before mentioned, the frontage is usually extended, and the direction of the attacking troops may vary according to the disposition of the enemy's forces; so that, as a rule, sites for dressing stations cannot be arranged for until the attack is well developed, and the areas in which the largest numbers of casualties are occurring are known.

The choice of sites for advanced and main dressing stations will usually be determined by Os.C. field ambulances.

The A.D.M.S. will bear in mind that the work of removing wounded during actual fighting must be left in all circumstances to the initiative of the Os.C. field ambulances, and the regimental medical services. He is mainly concerned in maintaining the link between them and the clearing hospitals, and in indicating the place to which field ambulances will send back their sick and wounded.

When the attack has developed, and the sites of the dressing stations have been determined—of which the A.D.M.S. should be at once informed—he will make arrangements with Q.M.G.'s branch as regards the means of evacuating casualties from the field medical units. There are various ways of doing this, depending on the amount of transport available, and the number of casualties to be dealt with. For example:—

(1) It may be considered best to evacuate direct to the clearing hospital from the main dressing station; this would probably be done by means of transport collected locally, or empty vehicles sent up for the purpose.

(2) It may be possible to evacuate all or the greater part by the mechanical transport lorries of the Supply Column; this probably entails bringing the wounded from the main dressing station to the divisional refilling point by means of ambulance wagons, or

empty wagons of the divisional supply train. This was tested in the recent medical manœuvres—successfully under peace conditions—but it appears somewhat doubtful if this method of evacuation can always be depended upon in war, as these supply lorries have to work strictly according to hours laid down, and cannot be delayed for other purposes, as the troops must be fed. They would, however, probably serve as a subsidiary means of evacuation, but not always a certain one.

(3) By bringing the clearing hospital to the field to take over the sick and wounded. In big engagements, when large numbers of casualties occur, this will be, I think, the usual method adopted, and points to the great necessity of providing the clearing hospital with rapid moving transport of its own. At present, the clearing hospital is in the anomalous position of being a clearing agency, without any means of transport for this specific purpose.

Whatever method of evacuation is adopted, it is most imperative that the field ambulances should be cleared, and be ready for a further immediate advance, after a successful attack.

The A.D.M.S. or his Staff Officer should always remain with divisional headquarters so as to receive messages from the medical units and keep himself informed of the progress of the fight, or any change in the military situation, and receive reports of the number of casualties. At present the means of communication between him and Os.C. field ambulances are somewhat limited, and it is hoped that there will be improvement in this respect, either by freer use of the divisional signal service, or by a more liberal supply of cycles to field ambulances. Free inter-communication between him and the medical units is essential for success.

If time or opportunity allows, he should visit the dressing stations, to see if the arrangements are working satisfactorily, or require modification. The medical units in reserve should be in convenient situations, and ready to move at short notice. In long-continued battles as big a reserve as possible should always be kept in hand. Indents to replenish the medical and surgical equipment of field units should be promptly dealt with, and every effort made to obtain these from the advanced depot of medical stores without delay.

The work of field ambulances and the regimental medical establishments is very fully and elaborately laid down in R.A.M.C. Training, and one can hardly better the instruction. As regards the regimental medical establishments, their object is to render first aid to the wounded, collect them as far as possible into groups,

regimental aid posts, under cover and out of line of fire, and keep in touch with the bearer divisions in rear. In doing this medical officers should remember that needless exposure of themselves or the bearers to the enemy's fire is unnecessary and reprehensible.

The O.C. field ambulance should ascertain, from the commander of the troops to which he is attached, the objective, direction of attack, and probable frontage, so as to facilitate his own arrangements. The present field ambulance is practically a combination of the old bearer company and field hospital under one commanding officer, so that he is in a better position to direct and control the operation of collecting wounded from the field and their removal to certain selected spots :—

This operation involves :—

The systematic clearing of definite areas by the bearer division, and keeping touch with regimental medical services; this should be under the direction of a selected officer.

The selection of suitable sites for advanced dressing stations, and the methodical use of the ambulance wagon transport between these points and main dressing stations.

The site of the main dressing station requires careful consideration and must not be too hastily decided upon. If the attack is a holding one, it may be necessary to open one some distance in rear —but, if the attack is vigorously pushed forward, it may be best to wait and establish it on the site of the original advanced dressing station. Tent subdivisions should only be opened as actually required, and the remainder kept in reserve as long as possible. Early communication must be sent to A.D.M.S. as regards the positions of the advanced dressing stations, main dressing stations, number of casualties and the situation generally, and communication with him must be maintained.

To ensure harmonious working, the O.C. must keep entire control of the unit, and maintain direct communication with its component parts. Section commanders should be left to carry out the ordinary detail work of their sections.

As the A.D.M.S. has to maintain the link between the field ambulances and the clearing hospital, so must the O.C. field ambulances maintain the link between the regimental medical services and the main dressing stations.

Careful attention to horse management is most essential. Teams of ambulance wagons can be interchanged with those of G.S. wagons.

In a successful attack, it must be remembered that probably a

large number of the enemy's casualties will have to be dealt with in addition.

IN OPERATIONS OF DEFENCE.

Preliminary measures are of a similar nature, but arrangements can be more deliberately made beforehand as to the site of the dressing stations and the method of evacuation of wounded to the rear. It is important, however, to keep a good reserve ready at hand, in the event of a counter attack being delivered against the enemy.

At the conclusion of his paper Lieutenant-Colonel Hunter gave a demonstration, with maps, of the employment of medical units in battles of attack and of defence respectively.

DISCUSSION.

Surgeon-General WHITEHEAD, C.B., after thanking Colonel Hunter for his very interesting paper, said: The subject of medical tactics is by no means easy to grasp, and there is very little literature available on it. The rules laid down in R.A.M.C. training form a good basis, but the test of active service is still wanting. One of the most important things is perfect co-operation between the A.D.M.S. and the O.C. Field Ambulance.

(1) The A.D.M.S. must convey information and orders clearly to Os.C. Field Ambulances, and receive information from those officers. This involves the difficult question of intercommunication. Great assistance, it is hoped, will be obtained from the divisional signal company, whose services may be to some extent available for our purposes.

(2) One must be careful not to commit oneself as to the positions of dressing stations, &c., until the scope of the operations is revealed.

(3) It is essential that there be close co-operation between the A.D.M.S. and G.O.C. and his staff.

The principle of keeping reserve medical units in hand is important. The battle of Sha-Ho lasted a long time, as all modern battles are likely to do; we must, therefore, guard against squandering sections unnecessarily early in the engagement. It may be very difficult owing to distance for the A.D.M.S. to keep in touch with the distribution of his field ambulances, which should prompt his giving every latitude to the officers commanding those units.

With regard to clearing the field units, how much time does it take to load up the motor lorries? The amount of time available for this is likely to be small as these vehicles work according to a time table. A further question is whether the field ambulance as now constituted is a good unit in all respects. Is it too big, or to small for its purpose? Can it be efficiently supervised by one commanding officer? These points are at least open to discussion.

With regard to the medical arrangements in an "encounter" battle—a very difficult problem—how should we best dispose of the field medical units? The field ambulances are a long way behind in ordinary march formations. How are they to be got up in the hurry of an unexpected engagement?

Colonel WHIGHAM, D.S.O., General Staff, said: There are three very important points raised in the paper and by the last speaker: (1) Intercommunication; (2) transport; and (3) the disposal of medical units on the line of march when an encounter is possible. Field service regulations lay down the principle that all units must be so placed during the march that they will be available if required. The carrying out of this principle is the duty of the commander. On the march even where fighting is expected medical units must necessarily be some distance behind, but there should be a sufficient distribution of ambulance wagons throughout the column, and a medical detachment, such as a bearer subdivision, should accompany the advance guard. I have often seen a complete section of a field ambulance detailed for the latter purpose on manœuvres, but such an unwieldy detachment is unsuitable for the purpose. The advance guard, having come into contact with the enemy, would in all probability occupy a position and thus gain time to allow the column to deploy. This deployment would be a matter of at least two or three hours, so that there is likely to be plenty of time to bring up medical units from the rear. This, too, will enable the A.D.M.S. to find out the commander's intentions and then distribute the medical units with deliberation and success when they arrive. The A.D.M.S. *must* be in the confidence of the commander, and he should be able not merely to understand his instructions, but also to anticipate what a commander is likely to wish to do. General tactics are, therefore, well worth the study of medical officers charged with administration. In quartering troops the same principles apply as on the march. The question is not as to where the units may be most conveniently located for the night, but where they will be wanted next day. As to the question of a divisional, as opposed to a brigade, organization of medical units, a divisional organization is now finally adopted, and this is well as brigades are not likely to suffer equally, and it is important to be able to keep certain medical units in reserve and have them available for use when required. The A.D.M.S. should not invariably detail medical establishments for all detachments. He must be in touch with the requirements of each detached force through the staff and be prepared to supply medical aid when it is necessary.

As to intercommunication, the Signal Company is a new departure. It is a divisional unit run from the divisional headquarters. It will establish a certain number of "post offices" in the area of operations for the use of *all* the troops in that area—medical or other. Where, as in European warfare, the frontages are much smaller than in, say, the

South African War, it is unlikely the Os.C. Field Ambulances will ever be far from a "post-office." As regards increasing the number of signallers in medical or other units: We have got to a limit now and it is even proposed to reduce the signallers in field units as unnecessary since the introduction of the signal company, thus making more men available for fighting or technical duties. Apparently the signal companies did well on the recent manœuvres. The movements of troops are much quicker on peace manœuvres than during actual fighting, which is more deliberate and gives more time. The best way to facilitate medical intercommunication is for the A.D.M.S. to remain at headquarters himself. Colonel Hunter suggests that the A.D.M.S. should himself visit his dressing stations; if this is done at all it must be during a lull in the fighting. I think on principle he had better stay where he can control and direct, like the G.O.C. himself. He must never get a *local* as opposed to a *general* view of the situation or he will be likely to lose his sense of proportion.

As to transport, if the General desires that the motor lorries are to be used for the removal of wounded there will be no question of interfering with the time-table. The lorries are not for such use without superior orders, and, acting under such orders, they are independent of any time-table. They will be available in all probability to a greater extent than is supposed. The soldier now carries one "iron" ration and is, therefore, much more independent of the supply columns than formerly. Apparently the Bulgarians have recently made very successful use of local transport, but all this was carefully pre-arranged. We are not likely to find much local transport during operations in European countries. As regards the transport for clearing hospitals the I.G.C. is always responsible for the supply of transport for these units. A certain percentage of spare vehicles allowed for in the mobilization equipment of the mechanical transport forms a reserve kept up during operations by the I.G.C., and is at his disposal for clearing hospitals and other purposes. This transport is thus available for whichever clearing hospital may require it, since it is obvious that all clearing hospitals will not be equally in demand at all times. Having regard to the constitution and purposes of our expeditionary force it is necessary to cut down transport as far as possible. The principle which guides us is not the allotment of a certain amount of transport to every unit *but the collection of transport in bulk and its distribution as required.* It may be assumed that the I.G.C. will not be found wanting in this respect.

Lieutenant-Colonel Burtchaell said: Colonel Hunter includes under the title "Medical Tactics" all the procedures incidental to the removal of a wounded man from the firing line to the base. Various books and articles published in foreign countries during recent years use the expression in an equally wide sense. In doing so two distinct issues appear to be confounded, (1) the rescue, first aid, collection and tem-

porary removal of wounded on the battlefield in situations which admit of this being done while fighting is going on, and (2) the evacuation of wounded from the battle area towards the base. The first appears to merit the title "Medical Tactics," properly so-called, as the work necessitates conformity to the tactical dispositions of the fighting troops, and a knowledge of how to use ground to the best advantage for the object in view. The second is not a tactical problem at all and should be considered separately, in its broader aspect at all events, as an administrative procedure, to be arranged for in conjunction with the branches of the staff concerned, and it is dependent upon the nature of the lines of communication, class and capacity of transport vehicles, railway rolling stock and personnel available. From a training point of view this division is of some consequence. In war the majority of Royal Army Medical Corps officers will have to deal with problems of a medical tactical nature, and relatively few will be concerned with the administrative arrangements for evacuation from one or more divisions or an army. To a certain extent proficiency in solving administrative problems of this kind can be attained by studying schemes with a map, as, given the necessary data, the problem mainly resolves itself into one of simple arithmetical calculation. This is not so as regards medical tactics, which cannot be learnt from maps, essays, or history alone, as a requisite knowledge of the subject can only be acquired by practical work with troops in the field, or by working out problems on the ground. We have had instances of officers apparently conversant with the theory of medical tactics who got into difficulties when they came to deal with practical situations, owing to want of experience in finding their way about and picking up positions on the ground. Medical staff tours for junior Royal Army Medical Corps officers are often run on too elaborate a scale. Valuable instruction may be obtained by working out the medical side of tactical problems—in conjunction with a general staff officer when possible—on ground in the immediate vicinity of a military station, and Royal Army Medical Corps officers who are attached to fighting units during the training season can obtain much useful knowledge by observing the operations of the troops and working out, mentally or on paper, how the wounded would be dealt with in the various situations which arise.

When considering the factors which make for success we must not forget that the ultimate well-being of the wounded is the end to which medical tactics are the means, and it is essential to keep constantly in mind the vital importance of sound judgment and thoroughness in the initial surgical treatment of serious wounds and immobilization of fractures—a point to which it is not easy to give sufficient prominence under the artificial conditions of training. As regards the present field medical organization it is a question whether, when fighting is not imminent, field ambulances might not with advantage be temporarily attached to infantry

brigades for march purposes, with a view to camping or billeting facilities and convenience of position in the column for receiving the sick of units. When fighting occurs they would come directly under the control of the A.D.M.S. in the same way that the former brigade field hospitals and bearer companies came under the P.M.O. during an action. The field ambulance has its points, but it can hardly be described as an ideal unit. The commanding officer cannot possibly control the bearer division during an action unless he goes forward in command of it himself and leaves the rest of his unit, and in any case the occasions on which he will not have to detach some portions of the unit, as a practically independent command for the time being will probably be rare.

There can be no doubt that while an action is developing the working of the divisional organization depends upon the A.D.M.S. or his representative remaining with divisional headquarters. This has been well brought out at the medical manœuvres. The adequacy of the means of communication is invariably questioned whenever a discussion on medical tactics arises, but the difficulties seem to be overrated, as the time available for placing medical units will be much greater in war than in peace manœuvres and the distances will probably be less. At the Sha-Ho, which may not be typical of future battles, one could have walked round the area of the daily operations of any one of the divisions of the 2nd Japanese Army. At practice exercises attempts are often made to communicate information which is not obviously essential. Field Service Regulations, Part I, says that subordinate commanders are to communicate *important changes* in the situation, and field ambulances should follow the rule, but avoid sending messages which have no bearing on any action that can be taken, either immediate or remote.

It is frequently assumed that the regimental medical establishments should keep in communication with the bearer division, and the latter with the tent division, but this is impracticable and often impossible. The chain of communication must be from behind forwards and not from front to rear, the bearer division sending forward an officer to watch the movements of the fighting troops and, if possible, to mark the position of casualties, so that the bearers may be brought directly to the area where their services are most required so soon as the situation admits of their advance. Similarly the tent division should keep in touch with the bearer division.

With regard to divisional orders, when a field ambulance, or a portion of one, forms part of a detached force placed under a named commander, the A.D.M.S. should not issue any executive orders to it—if it is necessary to do so the orders should be sent to the commander of the detached force through the divisional staff.

As to the allotting of roads for the use of medical units, if defensive operations are expected, it is not clear how the staff would be able to do this before contact with the enemy is obtained, as no one could tell where or when casualties would occur.

For the same reason it is often impossible to name sites for dressing stations, areas, &c., in Royal Army Medical Corps orders.

It has been mentioned that the A.D.M.S. should maintain the link between the field ambulance and the clearing hospital, but normally the A.D.M.S. has no control over the latter unit, which is under the orders of the I.G.C.

It seems useless to speculate on having wagons collected locally for evacuation. Even if the Q.M.G.'s branch of the staff did obtain any such vehicles, the difficulties in dealing with them and keeping the drivers under control would probably be great.

Lieutenant-Colonel Hunter seems satisfied with the result of the test of the motor lorries of the supply column for evacuation of wounded at the medical manœuvres last year. It certainly proved that they are suitable for the purpose if adequately fitted up, but the number of men to be evacuated on the occasion in question could not have been loaded up and got away in any reasonable time under the arrangements that were made. The wounded were concentrated at a single point just off the road and only one lorry was loaded at a time. If the wounded had been classified and grouped at intervals along the road with sufficient personnel for loading the operation might have been successfully accomplished. It was certainly made clear that some such arrangement must be thought out beforehand and everything prepared for rapid loading before the lorries arrive at the appointed site.

The battle of Sha-Ho presented a singularly easy medical problem, as during six days the second Japanese Army advanced only about nine miles, and the frontage of each division was approximately two miles At the medical manœuvres last year one division was spread over a frontage almost equal to that of three divisions at the Sha-Ho—about six miles—and the medical problem, apart from rapidity of movement, was more difficult.

Lieutenant-Colonel HUNTER, in his reply, said: The selection of the battle of Sha-Ho as an illustration was not on account of any special difficulty in the problems there presented, but merely to give an idea of a continuous battle of attack, in which the medical arrangements had to be adapted to a continuous advance. He noted that as regards intercommunication, Colonel Whigham thought it unlikely that the divisional signal company would be supplemented by an increase in the means of communication belonging to field units. It seemed clear, too, that the I.G.C. is absolutely responsible for the evacuation of the wounded. The responsibility, therefore, would rest with that officer if insufficient transport was forthcoming for the clearing hospitals. Colonel Hunter regretted that the lateness of the hour prevented him from making a fuller reply to the points raised in the discussion, and thanked those officers who had taken part in it.

Clinical and other Notes.

OUR AMBULANCE WAGON, AND HOW IT WAS MADE.

By W. ERNEST NELSON, M.A., M.R.C.S., L.R.C.P.
Commandant of Henley-in-Arden Men's Detachment, Warwick, No. 11.

A Men's Voluntary Aid Detachment is often at a disadvantage, because it has not got an efficient ambulance wagon for use at drills, practices, displays, or inspections. In this short description I hope to show how any detachment may, at a very small cost, provide itself with a really efficient ambulance wagon. The first thing to do is to select your wagon; the second to make arrangements for the use of it; the third to adapt it for ambulance work.

The Selection of the Wagon.—For the purpose required a wagon or trolley, as shown in the accompanying illustration (fig. 1) is perhaps the most suitable. The type is a common one, and one or more of this type is likely to be found in most country towns or villages. It should be light to draw, but at the same time strongly built, and special care should be taken to see that the springs, wheels, and axles are in good condition.

Arrangements for its Use.—I selected the wagon that I thought most suitable, and then approached the owner, our local fruiterer, Mr. A. Sammons, of Henley-in-Arden. Here I was fortunate in meeting with a patriotic man, and I am quite sure that Mr. Sammons would have lent us his trolley without any return at all. However, one good turn deserves another; so I suggested that we should give him a set of wooden hoops to carry the covering for his cart; hitherto it had only been spread over the hampers, &c.; in return for this, he agreed to lend us the cart for ambulance practice when required. The cost of the set of hoops was 12s. 6d. (fig. 2).

Adaptation for Ambulance Work.—We had now got our wagon, and also the framework for the covering; the next question was, how could it be made capable of carrying stretchers? As the woodwork forming the hoops was much too thin to be of any practical use I had a strong framework made to fit on the floor of the wagon under the frame for the covering. This I call the stretcher frame; it consists of six parts—two wooden frames and four light iron rods (fig. 3). To fix it together the two wooden frames are placed opposite to each other; these are then made quite rigid by the iron rods, the ends of which are turned over at a right angle for about 1½ in.—the parts turned over fitting into iron rings, which are fastened by plates to the woodwork of the frame—the iron plates which carry the rings being set at a suitable angle. By this method of fixing the frame is rendered quite rigid, and should the cart

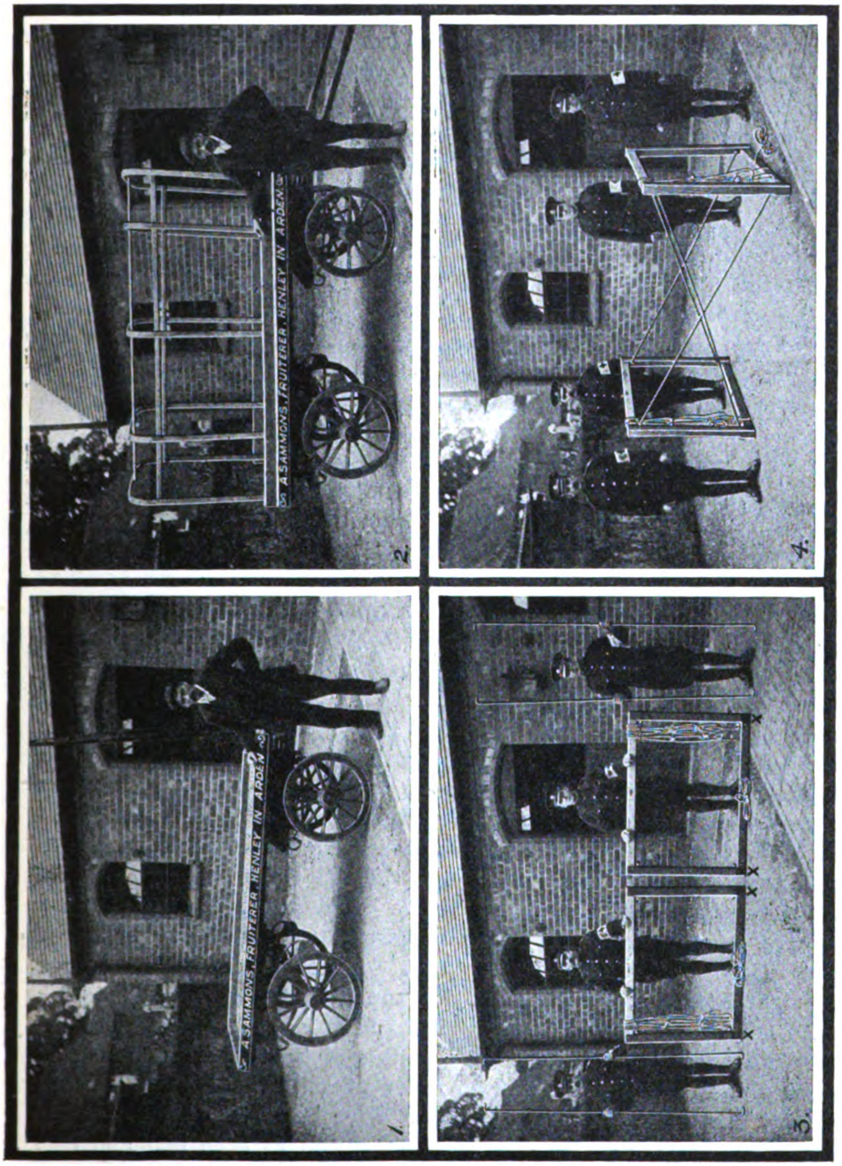


Fig. 1.—Our local fruiterer's four-wheeled cart.
Fig. 2.—The cart fitted with a set of wooden hoops to carry the cover.
Fig. 3.—The six parts of the stretcher frame.
Fig. 4.—The stretcher frame put together on the ground.

not be available it could be used on the ground for practice in slinging stretchers (fig. 4). To give the frame additional rigidity when fixed in the cart flap hinges are fixed on the wooden frames, two on each (fig. 3x x); the pins have been removed from these hinges, and one half of each pair of hinges is fixed to the frames, the other half is fixed permanently to the flooring of the cart; the exact position for the frame is thus marked on the floor of the cart, and when in position the pins are pushed in (fig. 5). The wooden frames must be strongly and well made; the uprights should be of good deal (3 in. by 3 in.); the cross-bar is the most important, and should be of well-seasoned deal or pitch pine, free from knots, 3 in. by 1½ in., the thin edge uppermost, and the ends let into the uprights to the full 3 in. The top edge should be very slightly rounded so that it does not cut the cords. Four stretchers can be hung from this frame by means of cords, suitably tied, with firm reef knots. The space between the upper and lower tier must necessarily vary with the height of the hoops; in the present case the total height available is under 4 ft. The measurements of the floor of the wagon here described are as follows: length 8 ft. 4½ in. by 4 ft. 9½ in. wide. Each end of the stretcher frame measures 3 ft. 6 in. high by 4 ft. 8 in. wide, outside measurement. The distance apart of the ends of the frame must depend on the length of the stretchers used by the Detachment; the one here described is made for the standard Army or "Furley" stretchers, the poles of which are 7 ft. 9 in. long. The rope slings should be in such a position as to hold the stretcher handles about 4 in. from their ends; this means that the ends of the stretcher frame should be placed about 7 ft. 1 in. apart, measured from centre points, when standard stretchers are in use (fig. 6). It is of the greatest importance that very strong cord should be used, but at the same time it does not do to have it too thick. I find that the thickest kind of sash cord is the best; it has a diameter of about ½-in. only, but is exceedingly strong. Once the knots have been correctly tied, and it is seen that the stretchers all hang evenly when in position, the cords can be left hanging on the frames. When the frame is fixed, and the cord slings are hanging in their proper positions, the stretchers should be placed in the slings. This should be done in the following order: First, right-side top; second, left-side top; third, right-side bottom; fourth, left-side bottom, loading from the back of the cart. When all the stretchers are in the slings the handles of the stretchers must be laced to the frame at each end in order to keep the stretchers from swinging when the wagon is in motion. Five holes are bored in each bottom transverse bar of the stretcher frame, one at each end and one in the centre, the other two placed so as to make five holes with four equal spaces. A thin cord—a clothes' line does quite well—is then laced alternately through a hole and round a stretcher handle, being tied firmly to the frame at the odd holes, viz., 1, 3, and 5. By this method

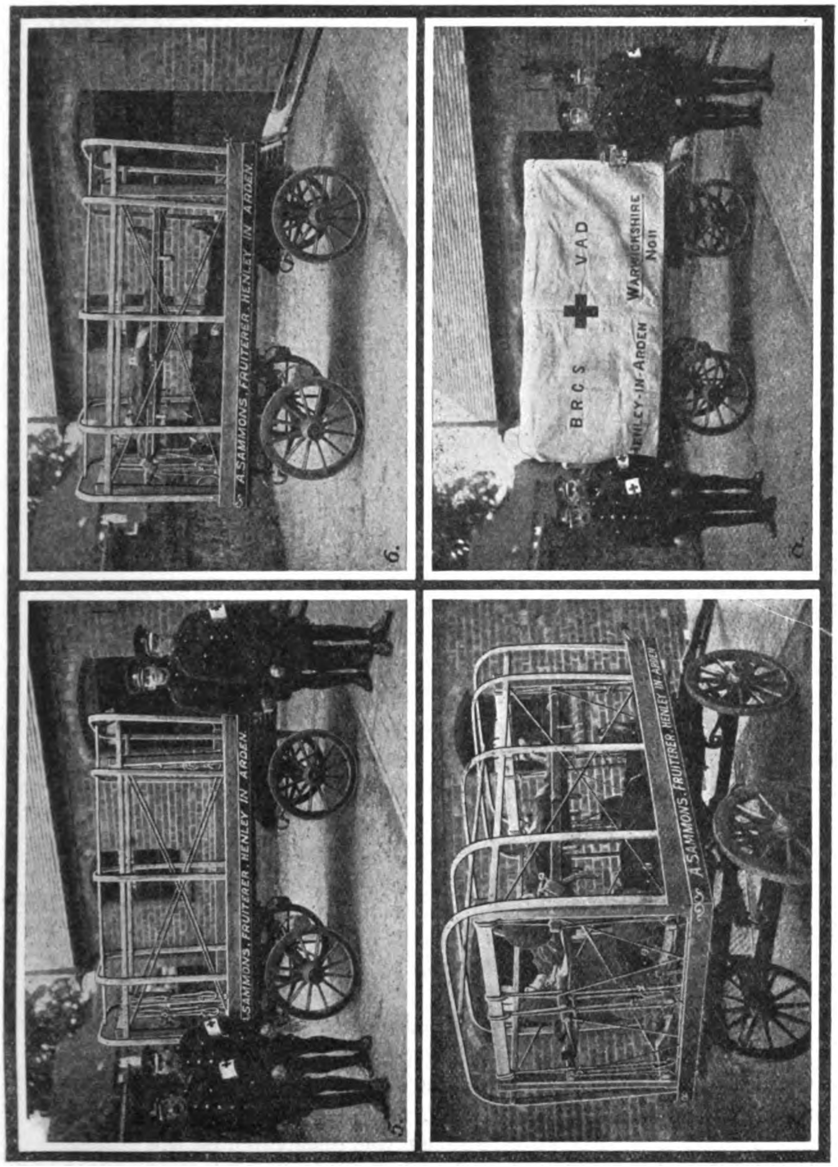


FIG. 5.—The stretcher frame in position on the cart.
FIG. 7.—End view—showing how the stretchers are kept in position by the system of lacing.

FIG. 6.—Four full-grown men on standard stretchers, all slung from the frame.
FIG. 8.—The cart fitted with special white tarpaulin cover.

of fixing all swinging is prevented, and the wagon can be taken with safety even over rough ground. We have proved this by taking our wagon fully loaded over fields, &c., without trouble of any kind. For method of fixing stretchers, &c., see figs. 6 and 7, which also shows four full-grown men in position on standard stretchers. The cost of the stretcher frame complete is under 10s., and it can be made by any local carpenter and blacksmith. Lastly, a suitable covering must be provided. Tarpaulin is, of course, the best, but it is expensive. The white tarpaulin cover shown (fig. 8) cost 30s.; the lettering is in black and the cross in red. A plain canvas cover could be made for less than half the cost of tarpaulin.

A wagon of this kind will be found most useful in many ways. On the occasion of the inspection of the Warwickshire Voluntary Aid Detachments at Warwick, on June 29, 1912, our wagon was sent to Emscote Wharf, Warwick, a distance of about twelve miles, in charge of two men, carrying, besides the stretcher frame, fourteen stretchers, two large boxes containing the detachment's equipment and all the ropes, poles, woodwork, and fittings for fitting out the barges for the transport of wounded,[1] which was the work assigned to our detachment on that occasion. During the afternoon the wagon was used as an ambulance wagon, and in the evening took the full load back to Henley-in-Arden.

FOUR CASES OF PERFORATED DUODENAL ULCER.

By Major J. W. H. HOUGHTON.
Royal Army Medical Corps.

The interest in these four cases lies in the fact that the diagnosis was confirmed on operation and that two recovered.

Private D. was admitted to the Cambridge Hospital, Aldershot, with a history of abdominal pain for three days gradually increasing in severity. On questioning him he would only admit to a pain in the abdomen on one occasion twelve months previously.

His symptoms on admission led to the opinion that he was possibly suffering from acute appendicitis, as the pain was referred to the lower part of the abdomen, and the abdominal wall below the umbilicus was rigid and retracted.

As there was a doubt concerning the site of his abdominal trouble, an incision was made on a level with the umbilicus and the right rectus muscle pulled inwards. On opening the abdomen some fluid was found. The appendix appeared to be healthy. The incision was accordingly extended upwards when a large perforation was discovered on the anterior wall of the duodenum. This was closed, and a posterior gastrojejuno-

[1] *See* Journal Royal Army Medical Corps, vol. xix, page 579.

stomy performed. The abdomen was drained through the right loin. The patient died within twenty-four hours of the operation.

The next case was Serjeant G., who was admitted to the Cambridge Hospital on March 9, 1912, with intense pain in the upper abdomen, and no history of recent illness. His pain was relieved by morphia. The following morning signs of peritonitis were marked, his abdomen was opened, and a perforating ulcer found in the first part of the duodenum. A gastrojejunostomy was performed and the abdomen mopped out and drained anteriorly. Unfortunately, this man also died within thirty hours as the peritonitis was of an intense character. The autopsy showed the gastrojejunostomy firmly united.

In these two cases the operation was performed at least twenty-four hours after the perforation had taken place.

Corporal H. was admitted at 11 p.m. on June 9, 1912, with intense pain in abdomen, which he stated began as he left the local theatre with his wife. When I saw him next morning peritonitis had set in, and on opening his abdomen a perforated ulcer was found in the duodenum, a posterior gastrojejunostomy was done, the abdomen mopped out and closed without a drain.

The wound healed *per primam*, but on the tenth day after the operation some pus collected at the upper end of the scar. This was evacuated and after a month the sinus closed, and he was discharged from hospital on August 26, 1912.

The last case is one which reflects much credit on the Medical Officer attached to a Territorial Regiment in camp near Aldershot.

Saddler H. was brought to the Cambridge Hospital at 10.20 p.m. on August 10, accompanied by the Regimental Medical Officer. This officer told me that the man had been seized with acute abdominal pain only two hours previously, and suspecting a perforated duodenal ulcer he had brought the man in promptly.

I operated at once and found a perforated gastric ulcer; the stomach contents had escaped into the abdomen. A gastro-enterostomy was performed and the abdomen mopped out. The wound was closed without a drain and healed *per primam*. The patient left hospital quite fit four weeks afterwards.

The last two cases were subjected to operation within twelve hours of the onset of symptoms.

NOTES ON A CASE OF A PARATYPHOID "A" CARRIER TREATED WITH A SPECIFIC VACCINE.[1]

By Major R. W. CLEMENTS and Captain W. R. GALWEY.
Royal Army Medical Corps.

The facts of the following case are drawn from our work at the Enteric Fever Convalescent Depot, Wellington, and inasmuch as they present features of importance we submit them for general information.

No. 6380 Lance-Corporal D. was admitted to the Section Hospital at Mhow on December 5, 1911. On December 7, the *B. paratyphosus* A was isolated from his blood and from his urine on December 27. The case may be described as rather severe, the temperature remaining high for about four weeks. The only symptom of interest as bearing on his present condition is that the urine contained blood for two or three days about three weeks after the temperature fell to normal. He had enteric fever at Poona in August, 1906.

On arrival at the Enteric Convalescent Depot the Widal reaction in a dilution of 1 in 100 was positive to *B. paratyphosus* A, and negative to *B. typhosus*. An examination of the urine showed a small quantity of albumin and a few pus cells. He never suffered from gonorrhœa, and there was no evidence of disease of the prostate or bladder.

The *B. paratyphosus* A has been isolated from the urine almost daily since March 19, and the tables attached show the dates on which the vaccine was administered and the doses, the dates on which the bacillus was isolated from the urine, and the results of Widal reactions using various strains of the *B. paratyphosus* A.

The vaccine treatment was continued for three months, and at the end of this period the urine contained about 20,000 bacilli per cubic centimetre. We decided to discontinue the vaccine, and at present he is having helmitol daily in small doses.

This case is of interest as showing the large doses of the vaccine we administered and which were well tolerated, as it is generally believed that a paratyphoid A vaccine is extremely toxic. From the facts revealed we suggest the time has come for the routine exhibition of a paratyphoid A emulsion in combination with one of *B. typhosus* with a view to the prophylactic inoculation against the two diseases which still are prevalent in India.

A rabbit was given several intraperitoneal injections from living cultures without showing any ill-effects, and the blood now gives a positive Widal reaction of 1 in 2,000.

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[1] The specific vaccine was prepared by the method described by Major H. W. Grattan, R.A.M.C.

RESULTS OF EXAMINATION OF FÆCES AND URINE.
No. 638, Lance-Corporal D., 2nd East Lancashire Regiment.

	March, 1912							April																									May														
Date	19	20	22	25	26	27	29	1	2	3	4	5	6	8	9	10	11	12	13	15	16	17	18	19	20	22	23	24	25	26	29	30	1	2	3	4	6	7	8	9	10	11	13	14	15	16	17
Fæces ..	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Urine.. ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

	May												June																									July									
Date	18	20	21	22	23	24	25	27	28	29	30	31	1	3	4	5	6	7	8	10	11	12	13	14	15	17	18	19	20	21	22	24	25	26	27	28	29	1	2	3	4	5	6	8	9	10	11
Fæces ..	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Urine.. ..	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	−

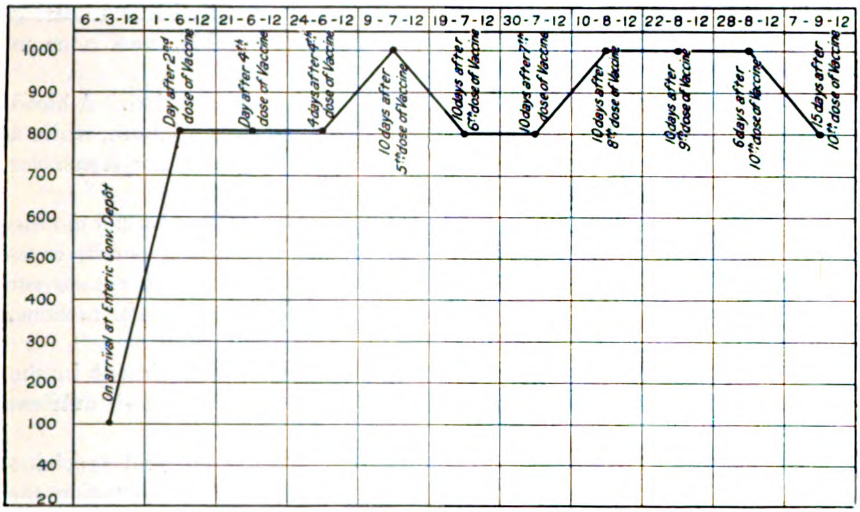
	July													August																		September																
Date	12	13	15	16	17	19	22	23	24	26	29	30	31	2	5	6	7	9	12	13	14	16	19	20	21	23	26	27	28	30	2	3	4	6	9	10	11	13	16	17	18	20	23	24	25	27	30
Fæces ..	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−								
Urine.. ..	+	+	+	−	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	−	−	+	+	+	+	+	+	+								

TABLE SHOWING THE DATES ON WHICH THE VACCINE WAS ADMINISTERED.

Date	Dose	Remarks
20.5.12	20 millions	Slight local reaction.
31.5.12	50 ,,	,, ,, ,,
10.6.12	100 ,,	No reaction.
20.6.12	200 ,,	Fever. Malaise. 24 hours.
29.6.12	400 ,,	No reaction.
10.7.12	400 ,,	,, ,,
20.7.12	400 ,,	,, ,,
31.7.12	800 ,,	,, ,,
12.8.12	800 ,,	,, ,,
23.8.12	800 ,,	,, ,,

RESULTS OF BLOOD EXAMINATIONS FOR WIDAL REACTIONS USING DIFFERENT STRAINS OF THE B. PARATYPHOSUS A AND THE STOCK LABORATORY CULTURE OF B. TYPHOSUS (BERLIN).

Date	Strain	Result	Remarks
6.3.12	*B. paratyphosus* A (Lab. Culture)	+ 1 in 100	On arrival at Depot.
1.6.12	,, ,, Dean	+ 1 in 800	Day after second dose of vaccine.
21.6.12	,, ,, Parel	+ 1 in 20	Day after fourth dose of vaccine.
21.6.12	,, ,, Dean	+ 1 in 800	Day after fourth dose of vaccine.
24.6.12	*B. typhosus*. Berlin	+ 1 in 100	Four days after fourth dose of vaccine.
	B. paratyphosus A (Lab. Culture)	+ 1 in 400	
	,, ,, Parel	+ 1 in 40	
	,, ,, Payne	+ 1 in 200	
	,, ,, Dean	+ 1 in 800	
9.7.12	*B. typhosus*. Berlin	+ 1 in 100	Ten days after fifth dose of vaccine.
	B. paratyphosus A. (Lab. Culture)	+ 1 in 500	
	,, ,, Parel	+ 1 in 100	
	,, ,, Payne	+ 1 in 300	
	,, ,, Dean	+ 1 in 1,000	
19.7.12	*B. typhosus*. Berlin	+ 1 in 100	Ten days after sixth dose of vaccine.
	B. paratyphosus A (Lab. Culture)	+ 1 in 100	
	,, ,, Parel	+ 1 in 40	
	,, ,, Payne	+ 1 in 600	
	,, ,, Dean	+ 1 in 800	
30.7.12	*B. typhosus*. Berlin	+ 1 in 100	Ten days after seventh dose of vaccine.
	B. paratyphosus A (Lab. Culture)	+ 1 in 600	
	,, ,, Parel	+ 1 in 100	
	,, ,, Payne	+ 1 in 600	
	,, ,, Dean	+ 1 in 800	
10.8.12	*B. typhosus*. Berlin	+ 1 in 100	Ten days after eighth dose of vaccine.
	B. paratyphosus A (Lab. Culture)	+ 1 in 1,000	
	,, ,, Parel	+ 1 in 20	
	,, ,, Payne	+ 1 in 1,000	
	,, ,, Dean	+ 1 in 1,000	
	,, ,, Murree.. ..	+ 1 in 800	
	,, ,, Joseph	+ 1 in 1,000	
	,, ,, Lucknow ..	+ 1 in 1,000	
	,, ,, Kengile ..	+ 1 in 1,000	
	,, ,, Smith	+ 1 in 800	
	,, ,, Fyzabad ..	+ 1 in 1,000	



No. 638 Lance-Corporal D., 2nd East Lancashire Regiment. Vaccine treatment commenced on May 20, 1912. Agglutinins to *B. paratyphosus* A (Dean).

A CASE OF HYPERTROPHIC STENOSIS OF THE PYLORUS IN AN ADULT.

By Lieutenant D. REYNOLDS.
Royal Army Medical Corps.

Lance-Corporal W., aged 35, first came under my notice at the end of July complaining of vomiting after food. He had had no pain, and had never noticed any blood in his vomit or stools.

Under treatment he improved and I lost sight of him until September 24, when I again saw him. He informed me that for the previous three weeks he had been unable to retain any solid food, and for the last few days had vomited even after taking liquids. On examination the man was in a very feeble and wasted condition with an extremely weak pulse. He weighed 8 st. 4 lb., and stated that three months before his weight had been over 12 st.

The vomiting which at first came on only once a day gradually became worse and followed every meal even if only fluids were taken.

On examination no lump or visible peristalsis could be seen, while on palpation all that could be made out was a slight rigidity of the upper part of the right rectus.

There was no enlargement of the liver or spleen, but the stomach gave a tympanitic note as high as the fifth left intercostal space and downwards nearly to the level of the umbilicus. His father had suffered

from chronic gastric ulcer, otherwise there was no family history bearing on the case. He gave no history of stomach trouble, and none to suggest gastric or duodenal ulcer.

Examination of the stomach contents gave no information. A blood count gave 2,450,000 red corpuscles and 8,000 white per c.mm., while a differential count showed a slight increase in polymorphonuclear leucocytes.

After admission he was unable to retain anything given by the mouth, except peptonized milk and albumin-water. The vomiting usually came on about half an hour after a meal, and was not of a violent nature nor suggestive of pyloric obstruction. There was no hæmatemesis or melæna, and he never complained of pain.

Under daily lavage he seemed to improve, taking nutriment in the form of peptonized milk, albumen water by the mouth, and nutrient enemata.

An exploratory laparotomy was suggested, but the surgical specialist did not consider an operation justifiable, taking into consideration the patient's condition. On October 26, the patient seemed to become much weaker, and on the following day the vomiting recommenced. He became gradually weaker and died on November 1, having taken nothing by the mouth during the previous twenty-four hours.

Result of Post-mortem Examination.—The body was very thin and emaciated. Heart and lungs were normal. The abdominal viscera, with the exception of the stomach and duodenum, were normal, and there were no enlarged glands, adhesions or ascites. The stomach was much enlarged and contained a quantity of partially digested milk, the walls being much thickened. At the pyloric end of the viscus, and reaching for about one inch into the duodenum, the walls were thickened to the extent of about a quarter of an inch. The lumen of the pylorus was much diminished, being about the size of a goose quill on its gastric side and nearly totally closed on its duodenal aspect. There was no sign of ulcer either of the stomach or duodenum.

MULTIPLE NEURITIS AMONG SOLDIERS IN CALCUTTA AND VICINITY—AN ENDEMIC, EPIDEMIC, SEASONAL DISEASE RESEMBLING BERI-BERI.

By Colonel F. SMITH and Captain A. E. F. HASTINGS.
Royal Army Medical Corps.

In these days when polyneuritis is almost universally regarded as due either to a diet of polished rice or to over-indulgence in alcohol, it seems desirable to place on record cases which are certainly not ascribable to either of the causes above mentioned.

The term beri-beri is, after all, only an Eastern name for multiple

neuritis, and was in use long before the polished-rice theory came into vogue. There seems no reason why the term should not continue to be used, just as we use the word malaria to denote the disease which is now known to be not due to bad air but to a parasite. Cases such as we are about to describe would, if they occurred among natives in Malaya, undoubtedly be called beri-beri.

For four consecutive years, at about the same season of each year, there has been recorded a moderate prevalence of polyneuritis in Calcutta among the European troops. This year (1912) is no exception. The disease appeared as usual towards the end of the rains; it has appeared also in the garrisons at Barrackpore, which is 12 miles away, and Lebong in the Darjeeling hills many miles from Calcutta.

The number of cases returned among the troops in Calcutta for the last four years has been as follows:—

In 1909	..	..	7	cases.
In 1910	..	..	3	,,
In 1911	..	..	10	,,
In 1912	..	..	6	,,

In the records of previous years I find only one case. It occurred in 1906 and was returned as beri-beri.

The prevalence at Lebong in 1911 was greater than at Calcutta—there were over fifty cases.

Last year the Lebong cases were sent to Barrackpore to convalesce. This year the disease has appeared among the European troops stationed in Barrackpore. Are these two facts in relation of cause and effect?

The disease at Calcutta has occurred mostly in the third quarter of the year—a hot, rainy period. Various foods and drinks, including water, have been suspected in turn as the cause. Analyses have been made in the fruitless search for toxic substances. Last year a note was made of the fact that one of the units most heavily attacked had previously served in Singapore, an endemic home of beri-beri. But the disease was known in Calcutta before the unit came from Singapore. The cases, too, were by no means all in men who had been in Singapore, and the disease attacked units which had not been in that station. Moreover, the unit from Singapore had not suffered from neuritis *while* there.

The disease at Lebong last year was first thought to be due to hill diarrhœa and to be mere debility, but this theory was soon abandoned. This year at Calcutta some of the cases followed immediately on dengue, but others were unconnected with that malady. Some of the cases were so mild at Lebong that the men were treated out of hospital; a few, on the other hand, at Calcutta and Lebong, were fatal.

The unit from Lebong came down to Calcutta for the King's visit last year (1911) and was encamped on the Maidan. Previous to its setting out on the march from Lebong several men were weeded out for œdema of the legs. Two cases were discovered on the march. For some weeks

after arrival in Calcutta the unit was free from neuritis; afterwards further cases occurred. Then the disease died out. Now, a year later, fresh cases have occurred.

Regarding the habits of the men: some led sedentary lives, others were active; some were total abstainers, others were moderate drinkers, while a few drank to excess.

As regards dietary: all the men had their rations, supplemented by suppers from the regimental supper-bar. The suppers consisted of meat cutlets, liver, fish, pies, &c. The vegetables supplied were fresh. Rice was rarely eaten more than twice a week. It was not the polished variety. Flour was used in bread, in puddings and in pies. It was suspected in its turn and examined for moulds, foreign grain, fermentation, &c. Ankylostomiasis was excluded by examination for ova.

The cause of the disorder remains a mystery. Cases, we believe, are met with among civilians in Calcutta; what relation, if any, it bears to endemic dropsy we cannot say, but according to Lieutenant-Colonel W. B. Thompson, R.A.M.C., who wrote as Officer-in-Charge Station Hospital, Calcutta, concerning the cases in 1909: "During and after the rainy season in Calcutta an epidemic of so-called epidemic dropsy was prevalent among the native population, thought by some to be a species of beri-beri. . . ." The 1911 report of the Inspector-General of Civil Hospitals — Colonel G. F. A. Harris, I.M.S. — is much more emphatic as to the prevalence of beri-beri in Calcutta. Under the heading "Beri-beri" this officer mentions that there were eight deaths, and he compares this with the high mortality (433 deaths) in Calcutta in 1909. He quotes Dr. Pearse, Health Officer of Calcutta, that "There is no evidence that the diet of the people has changed since 1909, and the milling of rice goes on exactly as before." Colonel Harris says the two diseases, epidemic dropsy and beri-beri, may be identical, but that it has not yet been satisfactorily proved that they are. The symptoms were those described in the text-books—the disease being mainly of the "dry" variety, though œdema of the legs was sometimes marked. Patchy anæsthesia of the lower limbs was noted, particularly on the inner side of the calf, with hyperæsthesia sometimes just beyond the line of anæsthesia. The hair over the anæsthetic patches was in some cases loose and easily pulled out. In one case the paralysis developed almost suddenly and was very extensive and persistent—the man being unable to stand. The patient was in hospital for seven days preceding the attack, and had been three days free from fever.

Among previous outbreaks of multiple neuritis in white men the following are worth noting:—

(1) Lieutenant-Colonel C. G. D. Mosse, Journal of the Royal Army Medical Corps, September, 1904. Ninety-one cases among Boer prisoners in St. Helena. The British Guard on the same dietary had

no cases. The disease had been imported into the island some seven months before by Norwegian sailors.

(2) Captain W. J. Waters, Journal of the Royal Army Medical Corps, February, 1908. Four cases of beri-beri in soldiers at Cawnpore in 1906.

(3) Fleet-Surgeon R. C. Munday, *Royal Navy Journal*, 1911, H.M.S. "Hyacinth," in the Persian Gulf, in 1909, had an outbreak of beri-beri among the Lascars. It was ascribed to polished rice. No Europeans were attacked. But in the following year when the Asiatics were affected only in slight degree, seventeen cases occurred among the European sailors, who, of course, were not on rice diet.

(4) Lieutenant-Colonel H. S. McGill, Journal of the Royal Army Medical Corps, February, 1910. Multiple neuritis among European troops at Poona in 1907—sixty-one cases—greatest monthly incidence in September and October.

Lecture.

REFLECTIONS ON THE NAPOLEONIC CAMPAIGN OF 1812.[1]

By Lieutenant-Colonel S. GUISE MOORES.
Royal Army Medical Corps.

This, as you are no doubt aware, is the centenary of Napoleon's campaign in Russia.

Various reasons are given for Napoleon's decision to wage war. His standards had hitherto been carried to victory over all the battlefields of Europe, and now with the insatiate impulse of the conqueror he wished to humble Alexander, and "throw himself upon Asia with all the concentrated forces of Europe." He was a fatalist, as is shown by his own words: "I feel myself impelled towards a goal with which I am unacquainted; when I shall have reached it, when I shall be no longer needed for it, an atom will suffice to throw me down; but until that moment all human efforts will be powerless against me." In this spirit he gathered together the mixed forces comprising the "Grande Armée." It consisted of troops mostly inured to war's vicissitudes. Its very magnitude, captained as it was by the greatest soldier of all time, made it the most formidable machine for war ever constructed.

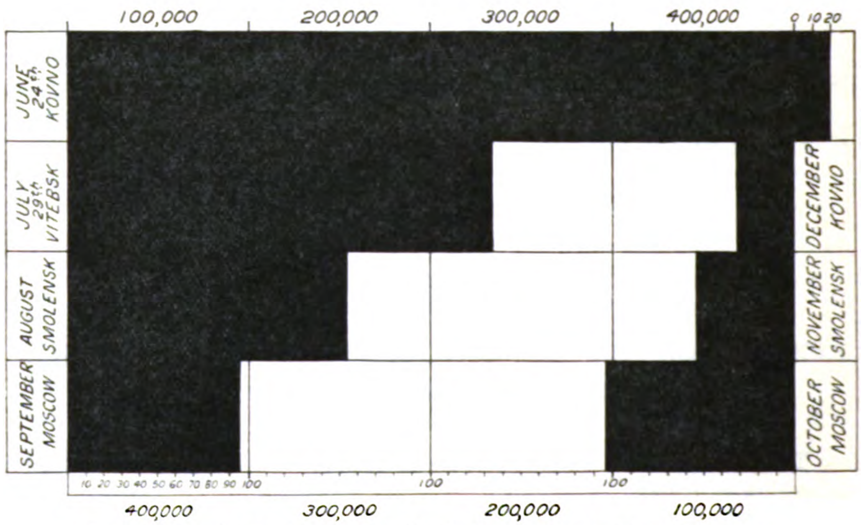
The Emperor studied the country he was about to invade very carefully—its roads, rivers, forests, &c. He also occupied his marvellous intellect on the question of construction and provision of transport

[1] Read before the Aldershot Command Military Medical Society

wagons suitable to the country to be traversed; for he early appreciated that supplies of all kinds would have to be carried with the army.

The medical arrangements were handed over to Baron Larrey, who, on receipt of the Emperor's commands from Berthier, took them in hand. When all was ready, Napoleon exclaimed, "You see I have never made greater preparations!"

It only remained to carry the war into the enemy's country, and with that object the movement towards the area of concentration now commenced.



Graphic showing wastage in Napoleon's Army, June to December, 1812.

The Grand Army concentrated on the Vistula, and from thence marched to the Niemen; it crossed that river on June 24, 420,000 strong. (See Appendix B.) A month later an additional 100,000 followed, making a total of 520,000.

Eight months passed—December 13—and the remnants of this once mighty force battled to recross the same river. How changed it now was, consisting only of a few thousand war-worn but desperate men, led by the gallant Ney—the master of rearguard actions.

How are these losses to be accounted for? Prisoners and stragglers cut off from the main body are said to be responsible for nearly 200,000. This leaves 300,000 who failed to respond to the roll-call; these all perished in an eight months' campaign either on the battlefield, or from wounds, disease, and privation. Included in this holocaust are 9,000 officers.

It is generally stated that an army requires renewal of about 80 per

cent. of its entire strength in the course of a year's campaigning, owing to depletion from various causes. To have kept the Grand Army up to its strength, a recruitment up to 96 per cent of its original strength would have been necessary, basing the calculation on only eight months' service in the field. As the last conscript had left France, replenishment from that source was impossible.

Let us assume that 20 per cent of the 300,000 were killed outright on the battlefield; it still leaves 240,000 to be accounted for. These succumbed in ill-found hospitals from disease and wounds; or on the march, from starvation, fatigue, and exposure.

The lessons that this, the greatest tragedy in history, teaches will be pointed out as the story proceeds.

It may be of interest to recall briefly some of the principal points in Napoleon's plan of campaign. His army stood in the form of a large crescent along the whole course of the Vistula. From its disposition the Russians could glean little as to the direction in which the Emperor would launch his legions. This uncertainty was intended to deceive, and to make the Russians divide their forces as they did.

In the middle of May, Bagration, with 66,000 men, was in Volhynia, near Lutsk; Barclay de Tolly, with his first army of 127,000, lay, extended from Schavli, through Vilna as far as Prushany. Marshy country separated the two. Afterwards, when the French army moved in a more northerly direction towards Kovno, on the Niemen, the Russians closed up; a third army under Tormassof formed the Russian left wing. Napoleon's plan was to pierce the Russian line by wedging the main mass of his army between Barclay and Bagration, via Kovno and Vilna. Then, as he said, "I will make them fight a big battle, and beat them," and "Alexander will sue for peace." It failed, owing to the inaptness of Jerome and the jealousy existing between him and Davoust; and also to Napoleon remaining quietly at Wilna and sending orders instead of conducting the operations personally by joining Jerome and Davoust.

The Russian forces eventually joined hands without accepting battle. They lured the French into the heart of Russia, marched them over barren wastes, and into towns devastated by fire, with the innate conviction that at no distant date starvation and fatigue, added to the rigours of winter, would finish off the work of death and dissolution nearly achieved by Russian arms.

Before following the advance of the main body to Vilna, and on to Moscow, it will be well to consider the organization of the French Army Medical Service at this period.

Larrey had been appointed Surgeon-General to the Grand Army, and Desgenettes, Physician-General. It is difficult to define the duties allotted to the latter; they probably consisted in the inspection of line of communication hospitals, and the supervision of medical cases admitted into

them. Larrey, in his memoirs gives us an insight into his work. He appears not only to have performed the administrative functions pertaining to his appointment as Surgeon-General in Chief, but also those of a working surgeon. In fact he was ubiquitous.

All regiments, cavalry and foot, possessed their own surgeons. During the Peninsular War McGrigor had sanctioned the employment of a regimental cart to follow each regiment. He was a confirmed believer in its necessity. The French Army also recognized its usefulness by having a four-horsed medical and surgical wagon carrying, in addition to sick, six stretchers and the medical and surgical panniers. Those who have had experience as medical officers in charge of a regimental unit in war will agree that such a vehicle is a very important factor in promoting the upkeep of a unit's numbers.

The first line field medical units with the French Army at this time consisted of "ambulances volantes." Six of these were formed and placed under the direction of their inventor, Baron Larrey. These flying ambulances were then considered to be "one of the happiest conceptions of the age." "They combined two principles; the first being a flying field hospital, organized for affording instant attention, and allowing the application of the first field dressings to the wounded on the field of action itself; the second, an arrangement for rapid transport to the field hospitals by means of specially adapted vehicles with trained conductors."

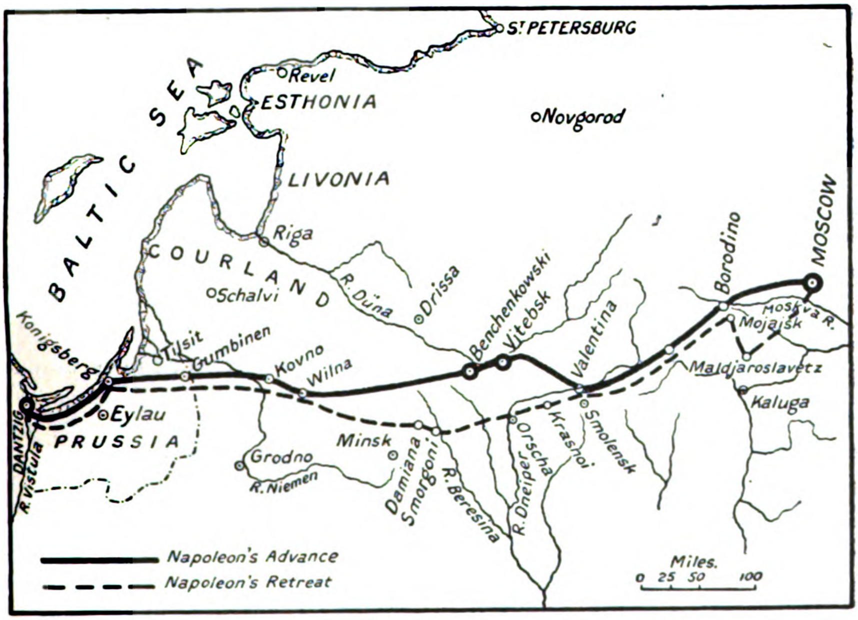
"The conveyances were so constructed, and the personnel so constituted, that the whole was capable of following the movements of an advanced force, however rapid. Each, moreover, was capable of being subdivided, and sent in a dozen different directions over a wide area." In other words, the organization of our present-day cavalry field ambulance strikingly resembles Larrey's unit, and the functions of our field ambulances and the *ambulances volantes* are practically identical. (See Appendix "A.")

In the second line followed the *ambulances* (movable field hospitals). The decree of 1806 detailed ambulances to regiments, divisions, army corps, and headquarters formations. The last was more amply equipped than the others, and had the ablest and most skilful surgeons attached to it. The ambulance marched in rear of the "military carriages," and did not reach the battlefield, as a rule, till about twenty-four hours after the engagement. The *ambulances volantes* evacuated into them, and they became in reality clearing hospitals, with this distinction from ours—they were mobile.

Line of communication hospitals were formed as required, and possibly were officered from the reserve of medical officers accompanying the army. Anything approaching the organization of our present-day general or stationary hospitals did not exist. One or two of the hospitals taken over at Moscow, Gumbinen, and Königsberg, more

nearly approached the ideals of our times, but even they were far from perfection. Depots for the reception and distribution of convalescents after discharge from hospital were recognized, but evidently were not formed in this campaign—except possibly in Moscow during its occupation. There were no depots of medical stores formed as such, but doubtless had it been possible to establish magazines they would have contained surgical and medical material.

Napoleon conducted in person the movement of the main body of his army to Vilna—the first objective of the campaign. He had with him Davoust, Oudinot, Ney, the Guards, and the cavalry divisions



Napoleon's advance to, and retreat from, Moscow, 1812.

of Nansouty and Montbrun. Larrey accompanied this force, which arrived at Kovno, and crossed the Niemen on June 24. Four days after it reached Vilna. It was a trying march owing to bad roads, made worse by continuous rain. A series of advanced guard skirmishes on the way accounted for 150 wounded, which were accommodated in the hospitals of St. James and Charity—the last nursed by the Grey Sisters. Larrey, anticipating that Vilna might one day have to provide shelter for a large number of casualties, left there the necessary "requirements" for the future treatment of 6,000 cases. It is not known of what these "requirements" consisted, or how long they lasted, but it is known that these

hospitals later on became storehouses of the dead, and that when the Russians entered the town after the French retreat, the hospital of St. Basile alone contained 8,000 "bearded dead," even its corridors and passages being filled with them.

Benchenkowski was the place at which the next engagement between advanced and rear guards occurred. There were 1,100 wounded, 500 of whom were Russians. They were attended to by the flying ambulances, and carried into several Jewish synagogues, hastily taken over as hospitals. The Geneva Convention was first given to the world in 1864, but the French Medical Service throughout this, as in other campaigns, invariably acted up to the principle since laid down in Article 6, which says: "Wounded and sick soldiers shall be entertained and taken care of, to whatever nation they belong."

On July 25 Barclay's army took up a position at Vitebsk. It was at the base of a semicircular hill, covering the approach to the town, and protected by the river Lutchessa. Barclay occupied it with the sole object of delaying Napoleon, and allowing Bagration to push on; this accomplished, he moved off at night, after an action between the French and his advanced posts had taken place. This contact resulted in 1,500 wounded. The surgeons ran short of dressings on the field, necessitating the use of their very shirts to obtain the linen required. Such an inadequacy did not look hopeful for the future, considering the army had only crossed the frontier a month previous.

The surgeons-major of the flying ambulances performed forty amputations on the field. The houses in the town were searched and some 350 Russian wounded were found. Their wounds, caused principally by howitzer shells, were in an advanced state of putrefaction. Indeed, in many, gangrene had already set in, though only a few days had elapsed since the receipt of the injuries.

The practice of the French surgeons of this time was "primary amputation" on the battlefield. Amputations delayed until the third or fourth day invariably succumbed. These cases proved no exception.

The Emperor pushed on incessantly. His forced marches, made in the hope of out-manœuvring the enemy and forcing him to battle, still proved ineffectual. He had already delayed at Vitebsk to bring up supplies, but these were now nearly exhausted, and man and beast were suffering, besides the pangs of hunger, from fatigue and heat when the Grand Army reached the outskirts of Smolensk, after having an advanced guard engagement near Krasnoi, *en route*. The 500 French wounded, with many from the enemy, were housed in a hospital fitted up on the battlefield, probably in farm buildings.

Behind Smolensk, Barclay and Bagration finally joined forces, and took up a position covering the town. On the afternoon of August 17, the French attacked, the Russian redoubts being stormed at the bayonet's point. After a stubborn resistance the Russians abandoned it in flames,

and with its abandonment Napoleon's plan for winning the Russian line of retreat to Moscow failed. On entering Smolensk the next morning Larrey selected the most suitable buildings available for hospitals, and converted fifteen to that purpose. All stores and supplies had been destroyed or removed by the enemy in his premeditated retreat.

Material for dressings did not exist; even personal linen had all been used up. Larrey, however, rose to the occasion. In his searchings he found a lumber store containing archives; these he used for dressings, splints, and bedding for 10,000 wounded. The *ambulances volantes* were able to attend to the greater number of casualties on the field. The breaches in the defence works, the gateways, and the streets of the town were all filled with dead and wounded. The surgeons toiled day and night, dressing, splinting, and amputating. Larrey, whose experience of battlefields must have been unique, said that the taking of Smolensk was the most sanguinary spectacle he had ever witnessed. Five *ambulances volantes* were detailed for duty, including all the officers of the French Medical Reserve. One flying ambulance was held in reserve.

The wounded, rapidly collected, were transferred by ambulance wagons or by hand to the hospitals prepared for their reception, several of which were close to prominent positions on the battlefield.

Hardly had the patients been accommodated when Larrey had to set out with his remaining flying ambulance to General Gudin's division, engaged at Valentina against Barclay. Barclay was protecting his retreat towards Moscow.

The wounded were sent to Smolensk, swelling the numbers already there. Reflect for a few moments on what must have been the end of these 11,000 stricken men. Half-starved, fatigued beyond endurance, contesting an enemy who only fought to delay, to retire, and fight again; to have their wounds "cleansed" with water from the carcase-fed Dnieper stream, dressed and splinted with archival parchments, and finally herded like cattle into buildings often roofless, and ill-suited in every hygienic and sanitary respect for their reception—no wonder they abandoned hope and died. Only the slightly wounded, who continued to follow the drum, had any chance of recovery.

Such a vast number of wounded necessarily required continuous attention, and with that knowledge the Surgeon-in-Chief left instructions before proceeding to Valentina that the officers of the French Medical Reserve must remain at Smolensk. The Grand Army was now reduced to 156,000 souls. The marshals were against any further forward movement, but the policy of the Emperor as a statesman over-ruled the strategical principles of the soldier. So, when he had concentrated his forces, and made some pretence of settling his supply arrangements and communications, he resolved to push on. He advanced in three columns towards Moscow. Larrey followed, after seeing the casualties of Gudin's division safely into Smolensk.

The march was now directed on Wiasma. On approaching the town it was committed to the flames by the Russians as they retired. Being the central commercial depot between European and Asiatic Russia, it was hoped to find supplies in considerable quantity accumulated there. But incendiarism had devoured what could not be removed, much to the disappointment of all, and in particular the Medical Service.

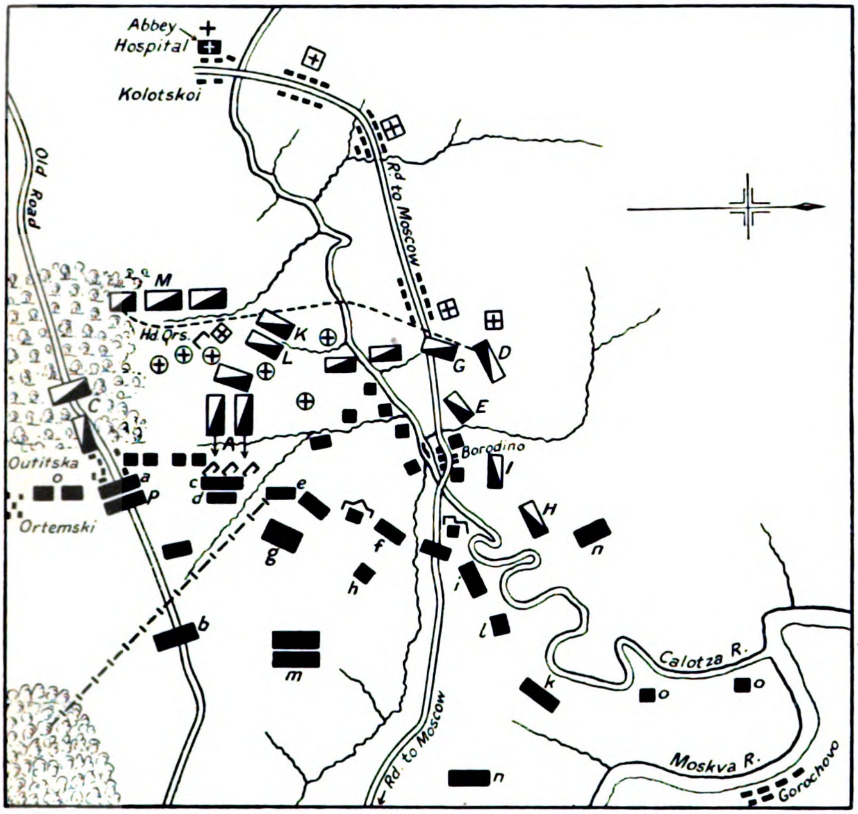
It should be noted that 22,000 men "disappeared" between Smolensk and Borodino. Desertion no doubt accounted for many, but privation and fatigue accounted for the remainder. Men fell out and succumbed on the roadside, or wandered into the rolling wastes to die. Discipline had long vanished. Rumour, though often a "lying jade," speaks truth on occasion; she gave out that the enemy had taken up a position at Borodino, and meant to stand and fight, and so it proved. This alteration of Russian plans followed the change of commander. Kutusoff had relieved Barclay. Having reconnoitred the future battlefield on his way to take up his new appointment, Kutusoff decided, and made his preparations, to receive battle.

Larrey was summoned to the presence of the Emperor, and told to make his arrangements for the coming battle. He had, as already pointed out, left his reserve of medical officers at Smolensk. His first action now was to reorganize the distribution of medical officers and to post them to units most requiring them. To carry this out, he obtained an order of the day directing that all regimental surgeons should be placed at his disposal. He could not without such an order move any of these officers, nor can an administrative medical officer of our Army do so at the present day without sanction of higher authority. By this means, he was able to secure the services of forty-five additional surgeons for his ambulances, leaving infantry regiments three, and cavalry two each.

The army of 130,000 men that faced an equal number of Russians at Borodino was already in an exhausted condition from want of food and water. Hopes long deferred, but now so dramatically, yet conditionally promised in Napoleon's address issued before the battle, alone buoyed it up. Here is the stirring appeal.

"Soldiers! here is the battle you have so much desired. Victory must depend on you. We need one in order to have abundance, good quarters, and a speedy return to France."

On September 5, the French began the attack on the advanced Russian entrenchments. Darkness supervening stopped a general action. The wounded were evacuated to the Abbey of Kolotskoi, near the scene of action. The next day was devoted to rest, rumination, and reconnaissance. The attack on the main position began at sunrise on September 7. Napoleon had determined on a frontal attack. A false demonstration was to be made on the village of Borodino, and a real one *en masse* on the Russian left wing.



FRENCH

French — Field Hospitals (Ambulances)

Amb. Volantes — L. of C. Hospitals

Position gained by the repulse of Bagration on the 5th and in which the French Army halted on 6th Sept.

A Ney B Davoust C Poniatowsky D Eugene E 2nd Div. of Davoust F Broussier G Grouchy H Ornano I Delzons K Junot L Latour M Impl. Guard

RUSSIANS

Russians — Redoubts — Mojaisk — Hospital

Position of the Russian Army after the Battle.

a Kanovnitzen b Militia c Woronzoff d Neverofsky e Reiefsky f Doctorof g Sievers h Pahlen i Shuvaloff k Bagavout l Korf m Guards n Ouvaroff Cavalry o Cossacks Platoff p Strogonoff

The Battle of Borodino, September 7, 1812.

On the French right was Prince Poniatowski, supported by Murat's cavalry; Davoust and Ney occupied the centre; Prince Eugène the left. The Guards with Napoleon were in rear of Davoust.

Glancing at the map, it will be noticed that four objects on the Russian position attract the eye: the village of Outitska on the old Moscow road, just seen behind the wood, through which the same road passes; to the north of these some small redoubts; further north the great redoubt; and still further north the village of Borodino, situated on the Kolatska and the road to Moscow. The attack was led by Davoust and Ney against the left and right of the Russian left wing. Murat supported. Poniatowski was given the task of turning the wood. The brunt of the fighting was borne by the Russian left wing, which eventually gave way to the French, after twelve hours desperate, dour fighting.

The French cavalry charged between the redoubts, but more than French steel was required to hurry, or flurry, the Russian infantryman. The French eventually took possession of the earthworks, the Russian left wing gradually retiring to its second position, fighting doggedly the whole way.

Borodino village was still in possession of the Russians when firing ceased at 8 p.m.

The troops occupying the right half of the Russian position had not been engaged. Kutusoff however, fearing that his left might be turned if he continued to hold on, and his retirement on Moscow thus circumvented, retired in the night in that direction. The gallant Bagration was killed, and 40,000 men were placed *hors-de-combat* on the Russian side. The French had 8 generals killed, 32 wounded, and 30,000 men killed or wounded. The flying ambulances worked in rear of the attacking divisions all day, the surgeons operating in the midst of heavy artillery fire. Larrey himself operated on or supervised the operations of 200 cases of major amputation under these conditions. The wounded were removed on the 8th and 9th to the various hospitals established (and shown on the map) by the ambulance wagons. Larrey and his confrères worked almost continuously throughout the day and night of the 7th and 8th, with little rest or sleep.

The wounds caused by artillery projectiles or musketry fire, delivered at short ranges, were mostly severe. The wind blew a gale during the engagement and the day following; so the wounded lay exposed to its penetrating blasts with only heaven's canopy overhead, and no warm bodily covering of any kind.

Once transferred to hospital, the medical personnel were able to bring back some warmth and life to these poor creatures, shaken by battle and tempest. There they received a potage composed of horse-flesh and cabbage-stalks, to which a few potatoes were added.

Splints and dressings were improvised from any materials close at

hand, which must have been anything but aseptic. When the village of Mojaisk was evacuated by the Russians, Larrey managed to secure several large houses which he converted into hospitals.

Early on September 14 the advanced guard reached high ground, from which could be seen Moscow, the goal of Napoleon's ambition. His army entered the old Muscovite city 90,000 strong, with about 20,000 wounded following in its train. Those not sufficiently disabled to prevent their walking, trickled in, in their own time.

Existing established hospitals were visited, and taken over by the military. They were mostly modern in construction and up-to-date institutions. Other buildings were also utilized for hospital purposes. So well were those on the sick list cared for that when Napoleon quitted this city he did so at the head of 105,000 men, only 1,200 sick being left behind. The patients remaining were placed in the Foundling Hospital, now appropriated as a military hospital, and "Three Divisions of Medical Officers" were left behind to look after them. To return to the ranks, in the space of a little over a month 90 per cent of the sick and wounded entering Moscow, alone justified the existence of the French Medical Service; for was this not a replenishing factor of supreme importance at such a juncture?

On October 19, Napoleon commenced his retrograde movement towards Kalouga. His army was accompanied by several thousand French subjects—men, women, and children—few of whom survived the trials of the retreat. Kalouga, the magnet which was attracting Napoleon, was said to be full of supplies for Kutusoff's troops. New country must be tapped if men were to be fed.

Kutusoff (hearing of Napoleon's movements from one Seslavin, who had penetrated into the Emperor's camp, and heard him give directions to his marshals) hastened Doktorov to Malojaroslavetz, to cut the French off. The fight for the village, which was taken and retaken eight times from the Russians, ended in the French keeping it; but the losses were so great as to necessitate caution in future action. Napoleon, owing to the weakness of his force, had at all costs to avoid a general action, and finding that Kutusoff now effectually barred the route to Kalouga, he changed direction, and marched for Mojaisk.

The wounded, about 2,000 in number, after receiving first aid on the field, were placed in the luxurious carriages looted from Moscow, which meandered slowly in rear of the force. On reaching Mojaisk, those unfit to travel were deposited in the hospitals there, and exchanged for a few convalescents able to fend for themselves.

When Kolotskoi was reached, all convalescents found in the Abbey Hospital were evacuated, and the wounded fit to move were accommodated in the carriages already referred to. The unfit to move were commended to the care of convalescent Russian officers, to whom Larrey gave money for the purchase of comforts. A similar evacuation

of convalescents took place at Wiazma, the next town on the route of retreat, the carriages being once more requisitioned for convalescents unfit to march. What became of the 4,000 killed and wounded in the engagement between Miloradovitch and Eugene at Wiazma on November 3 history does not relate. Probably they were left in that town. Since October 9 the army had been reduced by over 70,000 men, its strength on its arrival at Smolensk being 36,000. Most of the sick carriages by this time had been abandoned, owing to the horses dying from exhaustion; the inmates of those carriages still able to jog along soon succumbed from exposure to cold. Larrey mentions that many who rode died of gangrene of the extremities, and those who travelled in conveyances fell first into a state of stupor, followed by a deep sleep from which they never awoke. So the perambulating hospitals now became memories of the past, and the wounded such as were left walked, suffered and died.

The Smolensk hospitals, as the retreating force passed through, were filled with wounded.

In De Chambray's account of Ney's retreat from this town he tells of the fate of these wounded. He says, "The shock of exploding mines was heard, followed by the sight of lurid flames. The hospitals were now on fire. No surgeons had remained with the 5,000 sick and wounded left behind, and they had not been recommended to the mercy of the Russians, but abandoned as worthless instruments, henceforth useless." They were victims of a senseless and brutal vengeance.

On November 17 Napoleon was attacked at Krasnoe and had 1,200 casualties; these were left in the hospital established in that town, or taken on to Orscha, where it was expected to find "requisites" for their condition. Napoleon with the main body could wait no longer at Krasnoe. He left Ney with the rearguard far behind. Kutusoff, seizing his opportunity, placed his 80,000 men between the two, and so held the passage of the Dnieper. Ney's force consisted of 6,000 men (two divisions). With one division he attacked Kutusoff in a delaying action, waited till dusk, retiring east and north-east till he struck a stream leading to the Dnieper. He followed it along and crossed the Dnieper west of Kutusoff, but in doing so had to abandon 1,500 wounded, followers, stragglers, and all transport. Kutusoff's expectant host was left dumbfounded at the audacity of the manœuvre. So much has been written concerning the passage of the Beresina, that reference is advised for those desirous of knowledge of this rearguard action to the many standard works dealing with it. . . "There ended the career of the Grand Army which had made Europe tremble; it ceased to exist in a military sense, its only safety lay in headlong flight." It was here also that Larrey amputated General Zagouchek's thigh on the field, during a heavy fall of snow; two officers holding a cloak over patient and surgeon during the performance of the operation.

In Moore's retreat to Corunna no attempt was made to carry wounded unable to walk. The French surgeons picked up and cared for all who came into their hands. In this retreat, Larrey's method of carrying wounded in carriages is open to objection. It must have considerably delayed the retirement; and as it happens was of no useful purpose, for few survived its rigours. Ney, "the bravest of the brave," must have found the long-drawn-out line of invalid carriages a very decided check on his movements. It would have been better, in any case, not to have evacuated the hospitals of any wounded during the retreat, except those few found fit to return to the ranks.

As the French Army was a rapidly diminishing quantity, medical officers could have been spared to remain behind.

We know this was done at Moscow, and perhaps at other towns, but it was not done at Smolensk, with the consequences already related. To recommend wounded, left behind in an enemy's country, to the care of the enemy was a constant practice in those days, and it must under certain circumstances continue to be. McGrigor so acted after the assault of Burgos.[1] He then wrote to the Surgeon-in-Chief of the French Army in Spain, recommending the wounded to his care, and enclosing a sum of money for their sustenance. Larrey probably seldom had opportunities of doing so systematically in Russia, but one instance has already been given in which he acted in this way.

Humanitarians will tell you the chief functions of a Medical Service in war consists in attending the wounded on the battlefield, and the sick in hospital. Sanitarians will consider that prevention of disease in the field constitutes the chief function. Both are absolutely essential; but the commander who is dependent on big battalions to win battles will expect, besides these mainly medical functions, the discharge of two others, the functions of evacuation and replenishment.

These special military-medical functions are dependent on good organization; they consist in a rapid removal of the impedimenta of sick and wounded from the front, and their return to the fighting lines as quickly as possible. It is by the display of the two in unison that the destructive agencies of the enemy become neutralized.

Given a fully equipped and efficient Medical Service, all the functions named will be fulfilled, provided the requirements of supply and transport are efficiently organized.

An instance has already been related in this campaign in which the Medical Service was able to add in one month to the strength of Napoleon's fighting ranks 90 per cent of those previously wounded.

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[1] He left with the wounded, Assistant Surgeon Elkington, father of the late Deputy Surgeon-General Elkington, Brigade Surgeon, Brigade of Guards; and grandfather of Lieutenant-Colonel Elkington, R.A.M.C.

This addition was the outcome of a temporary efficiency rendered possible by the military situation at that particular time.

Napier, the historian of the Peninsular War, is responsible for relating of McGrigor a similar instance by which the destructive powers of the enemy were effectually counteracted, the Commander being enabled to enforce his will owing to the augmented strength of his force at the psychological moment. Napier says, "The extraordinary exertions of the medical officers of the army may be said to have decided the day at Vittoria, for their exertions had undoubtedly added a full division to the strength of Wellington's army, and without these 5,000 men it is doubtful if his lordship with his unrivalled talent could have carried the day."

Sufficient has already been said to show that the recognized functions of the Medical Service in this campaign were, owing to bad organization, impossible of fulfilment. The daily requirements of the fighting troops were never maintained, and when that happens the sick and wounded must suffer. Medical and surgical equipment ran short as early as July, and was never replenished. As a consequence wounded died of septicæmia, hospital gangrene, or tetanus, or if they mercifully escaped these, dysentery set in and completed the work. The sick and wounded were never evacuated from the so-called hospitals, owing to the complete breakdown of the transport arrangements. They were simply left to rot and die.

Both Larrey and Napoleon saw the paramount importance of removal of the wounded far away from the battlefield. In support of this conviction the wounded from the Battle of Eylau were transported by *ambulances volantes* wagons from the scene of action to a vast château at Inowraclow. This distance, performed by easy stages, was 165 miles. In advocating evacuation Larrey gives his reasons as follows: "Where the wounded remain largely assembled in one locality they are apt to fall into a profound discouragement, which is provoked by their own unhappy state. The abundant suppuration and the foul exhalations engendered by so many wounded men are fertile in producing hospital putrefaction, gangrene, and typhus. Each diseased man becomes a source of infection for his neighbour, and the presence of all develops an atmosphere so pestilential as to cause a larger number of deaths than the battlefield itself." This account is descriptive of what happened to the great numbers of wounded placed in the hospitals from Wilna to Moscow, both in advancing and retreating. Larrey did his best to evacuate these hospitals of all those fit to be moved in the retreat westwards; but it was a case of jumping from the frying-pan into the fire, for the hardships and risks run became even more pronounced than in hospital. Besides, a retreating army should not be incommoded with sick and wounded.

In previous Napoleonic campaigns there had been no necessity to augment a diminishing force with men returned to duty from the hos-

pitals. Had the hospitals and transport arrangements been specially organized, this campaign was one in which its army might have been replenished by such numbers as would have made it an instrument by which Napoleon's policy might possibly have been effectually carried out.

No further proof is required to convince all that the breakdown of this Army Medical Service, in this as in many other campaigns, was due to causes over which it had no control. The bravery, industry, and self-sacrifice of Larrey and his comrades stands out as a redeeming feature in this great tragedy. The Medical Service would not have failed had the organization of the French Army been adequate to the object it had in view, viz., the capture of Moscow and the maintenance of its army there. Had it been able to reduce to a minimum by good organization of its commissariat and transport arrangements, the casualties which every advancing army suffers, through battles, sickness, and absenteeism, by systematically replacing such losses, it would have been possible to have maintained its army in sufficient strength to reach its goal, protect its communications, and conduct a successful retreat.

Remarks by Major Butler, General Staff.

I do not propose to make any comments on the medical arrangements of the campaign, but I think a few remarks on the reasons for the failure of the operations from a general military point of view might be interesting.

The lecturer mentioned that Napoleon himself considered that he had made more elaborate preparations for the invasion of Russia than for any of his other campaigns, and I do not think that all the blame for the utter breakdown of the arrangements can be laid entirely on him. There is no doubt that he himself fully realized the magnitude of the undertaking, and gave the arrangements for it his full consideration, as was his wont.

Napoleon, after the campaign, threw all the blame on the elements: chiefly, I am inclined to think, as being the one thing for which he himself could not be held responsible. It is true that in the latter part of the campaign the army was in such a state that it could not combat the elements, and thus the weather, no doubt, became directly responsible for the great mortality, but it was not the weather which brought the army to that state.

Napoleon himself, as the lecturer has said, was not in good health, and though he issued elaborate orders he was not ubiquitous, he did not look into things personally as he had always done before. He had frequently impressed on his marshals the necessity for more elaborate preparations than usual, but he did not recognize that they, even more than himself, were not as young and energetic as they had been, and further, most of them had obtained all the fame and fortune that they could get, and were not keen on the war. This affected the operations adversely from the start.

Again, hitherto the armies which he had led had been composed chiefly of Frenchmen inspired by his personality, desirous of enhancing their own glory as well as that of France and the Emperor, and all striving for a common end. In this case he commanded a conglomeration of armies of many nations, some consisting of beaten enemies, and composed largely of men who were very far from being imbued with that spirit which had so often before given him the victory.

There was still another reason. Napoleon, as always, had carefully studied his opponents. He knew Alexander and some of his generals, and his knowledge led him to anticipate being able to bring off a battle fairly early in the campaign, but he knew little of Barclay, and less of Phull, and he did not expect that the latter's plan of always retiring would be accepted for long by Alexander, or be carried out so thoroughly by Barclay. As a matter of fact, as you know, eventually the Tsar did get tired of it; Barclay was suspended and Kutusoff put in command and made to fight at Borodino, but the change came too late for Napoleon.

Again, in all Napoleon's previous campaigns, as town after town came into his hands, he had been able to replenish his supplies and form magazines, and he had always been able to get the country people to bring in supplies. He never anticipated that his enemy would devastate their own country, and burn their own towns and villages; hence I am inclined to think it was, to some extent, actually his great previous experience of war that led him astray in this instance, and accounted for the extremely hazardous way in which he pushed on into Russia without properly organized supplies, ever with the goal of his enemy's magazines in view, at Vilna, at Smolensk, and finally at Moscow.

One other point. It is obvious that Napoleon stayed too long at Moscow, and that he alone was to blame for this. Here again his very experience of war seems to have led him astray. He had always hitherto found that his occupation of a foreign capital brought a sovereign and a country to terms, and he kept hanging on, loth to believe that success would not again, as always before, crown his efforts.

Remarks by the President, Lieutenant-Colonel G. D. Hunter, D.S.O., R.A.M.C.

Lieutenant-Colonel Guise Moores' graphic description of this disastrous campaign of Napoleon in Russia forcibly illustrates the great strain put on the Medical Services, even when well organized, when large numbers of casualties occur.

It also demonstrates the supreme importance of a well organized and efficient supply and transport service, not only for the maintenance of the force in the field, but for the removal of casualties from the area of operations.

APPENDIX A.

Comparison between

Larrey's "Ambulance volante," 1812, under P.M.O. in the Field	and	*Cavalry Field Ambulance (British) 1912 under A.D.M.S. Cavalry Division.*
1 Surgeon-Major, commanding.		1 Lieut.-Col. or Major, commanding.
14 Surgeons (all mounted).		6 Medical officers (mounted).
12 Spring vehicles {8, 2-wheeled (light). 4, 4-wheeled (heavy).		10 Ambulance wagons {6, 4-wheeled (light). 4, 4-wheeled (heavy).
4 Store wagons		6 Store wagons
37 Orderlies (12 mounted).		38 Bearers (dismounted).
1 Bugler.		2 Buglers.
25 Transport (personnel).		36 Transport (personnel).
1 Quartermaster.		2 Stewards.
2 Clerks.		2 Clerks.
32 Miscellaneous.		32 Miscellaneous.
....		....
113 (Personnel)		120 (Personnel).

APPENDIX B.

French Army.

	Corps	Numbers
	Napoleon. Garde Impériale	47,000
(1)	Davoust	72,000
(2)	Oudinot	37,000
(3)	Ney	39,000
(4)	Eugène	44,800
(5)	Poniatowski	36,300
(6)	St. Cyr	24,200
	Reserve Cavalry	38,200
(7)	Junot	17,800
(8)	Regnier	17,100
(9)	Schwartzenberg	32,200
(10)	Macdonald	32,500
(11)	Victor (not yet arrived)	33,500
	Grand total	471,600

Russian Army.

Corps

1st Army. General Barclay de Tolly.

(1) Wittgenstein.
(2) Baggowouth.
(3) Toutchakov.
(4) Schouvalof.
(5) Reserve.
(6) Grand Duke Constantine. Doctorov. Platov.

Cavalry of Reserve.

2nd Army. Bagration.

(7) Raeffskoi.
(8) Barosdin.

Cavalry of Reserve.

3rd Army. Tormassof.

Grand total 262,000

Reviews.

THE BACTERIOLOGY OF SURFACE WATERS IN THE TROPICS. By W. W. Clemesha, M.D. (Vict.), D.P.H., Major I.M.S. Calcutta: Thacker, Spink and Co.; London, E. and F. N. Spon, Ltd. 1912. Pp. 161.

In this book Major Clemesha has re-written and considerably extended his work on the bacteriology of Indian water supplies, previously published in 1909 as an appendix to the annual report of the King Institute of Madras. The book should be widely read by those who are interested in the analysis of drinking water supplies, not only in the Tropics, but in temperate climates as well.

His starting point is the suggestion made by MacConkey, in 1906, to divide up by means of definite cultural tests the large coli group of organisms into its component bacilli, and he goes on to prove that much knowledge can be gained by studying the various species of bacilli found in any water supply. The first part of the book deals with a large number of experiments to determine the approximate proportion of the different bacilli in human and animal fæces and in various waters. From this part of the work he considers the following wide conclusions justifiable: (1) That the flora of the intestinal tract of men and animals are subject to very considerable changes, due to influences which are at present unknown. These influences have been proved to operate over very wide areas. (2) That within certain very wide limits these forces appear to affect men and animals equally, both as regards the number and kind of micro-organisms. (3) That under well-defined conditions, such as heavy rainfall, the water supplies contain the same organisms as the fæces of men and animals at that particular time; but that this similarity of bacteriological flora is also noticed occasionally when rain is absent and there is no apparent cause for it. The explanation of this occurrence is at present unknown. (4) That having regard to the variation of the bacteria in fæces, both in quantity and kind, no constant approximate composition can be arrived at. Even in the large groups suggested by MacConkey, variation in percentage composition in the same animal is considerable. (5) No lactose fermenting organism has been isolated that has been proved to be the inhabitant of the intestinal tract of cattle or man only. (6) That the numerical relation of the organisms constituting MacConkey's groups in the intestine of cattle in India is entirely different to that in England; while in the intestine of man it appears to be very similar in the two countries. (7) That the study of the organisms present in the fæces at different times of the year is necessary for the proper interpretation of the results obtained from water analysis.

The significance of streptococci in water is next carefully considered, and Dr. Houston's conclusion that fæcal streptococci in water indicate recent and dangerous pollution is confirmed.

Chapter VI deals very fully with the prevalence and significance in surface waters of a class of organisms which ferment glucose, but not lactose. The advantage of employing both a glucose and a lactose bile salt medium in the search for fæcal organisms in water is strongly put,

and great stress is laid on the comparison of the relative amounts of water which give acid and gas in each of these media. From the results obtained the following conclusions are drawn:—

(1) That when dealing with natural waters the acid and gas line in glucose broth is usually higher than in lactose; (2) that, speaking broadly, the more recent the pollution is, the nearer together is the acid and gas line in glucose and lactose broth; the older it is, the greater the divergence.

Chapters VII, VIII and IX deal with the action of direct sunlight on the common fæcal organisms, and contain the details of an immense number of experiments. The result of these experiments seems to justify the division of fæcal organisms into three classes:—

(1) The delicate organisms or those that are very susceptible to the action of direct sunlight (*e.g.*, *Bacillus coli communis*).

(2) An intermediate class, containing a large number of organisms which occupy a position midway between the two extremes.

(3) The resistant organisms, or those capable of resisting the action of sunlight for a considerable length of time (*e.g.*, *B. cloacæ* and *B. grunthal*).

The reasons for placing *B. grunthal* among the most resistant organisms are not quite convincing. It is possible that its persistence in many cases was due to the large numbers originally in the water, and the conclusion that it is a resistant organism is contrary to our experience, which has invariably shown the organisms of MacConkey's Group I to be very susceptible, and the cane sugar fermenters to be the most resistant. In Chapter X is discussed the position in nature of certain of the fæcal organisms of these three new classes. The chief points laid down are that *B. coli communis* of Escherich is a very susceptible organism, and that *B. lactis aërogenes* and an organism, fermenting glucose and lactose which the author calls *Bacillus P.*, are able to increase and multiply in water. It is worthy of note that the latter organism is also a cane sugar fermenter.

In applying the results of his research to water analysis the author advocates, for surface waters at any rate, a qualitative, rather than a quantitative estimation of the fæcal organisms present in water. The kind of organisms, he says, should be studied rather than their number, in order to arrive at a satisfactory conclusion. In examining a water the following points are recommended to be noted:—

(1) Total colonies on agar at 37 C.
(2) Presence or absence of streptococci in 20 c.c.
(3) Divergence of acid and gas line in glucose and lactose broth.
(4) Presence or absence of his Class I (susceptible organisms).
(5) Predominance of his Classes II or III (resistant organisms).

In the last chapter the author compares his own method of judging a water, from the separate species of the organisms found, with the quantitative "coli" method in use in Europe and America. This chapter is an indictment of the methods, more especially of Houston and Savage, of describing *B. coli* as having certain characteristics and applying these to the organisms found in Indian water supplies. This indictment is certainly unjust to these great authorities, as the conditions of their work are admitted by the author himself to be very different to those holding good in the Tropics. Granted that the work of Major Clemesha is an

advance on the methods of these observers in dealing with Indian water supplies, we see in this no reason utterly to condemn methods which have been found adequate for home water supplies.

Full details of the technique and the media used are given in the appendices. The book is largely interleaved with tables giving the results of the experiments carried out.

Some of the author's deductions will be found open to criticism, and in places his enthusiasm has run away with his better judgment, but the value of the book lies in the opportunity it gives to sanitarians in other countries to take up similar lines of research. The originality of the research can best be summed up in the words of the author himself. . . . "Who ever heard it even suggested, that by the 'coli' method it would be possible for an analyst to say from his results if a water was taken from a lake nearly empty, or from a well after long drought? Who ever reported that such and such a mixture of fæcal organisms was highly suggestive of fresh fæces, or that such and such another mixture suggested that some alteration from natural conditions had occurred? Was it ever seriously put forward that *B. cloacæ, lactis aërogenes* and *oxytocus perniciosus* might be as valuable in indicating a certain definite stage in pollution as 'true coli' itself? Would it have been possible, working with the 'true coli' method, to discover the many interesting problems connected with animal and human fæces mentioned in this work?"

H. B. F.

STUDIES IN CLINICAL MEDICINE. 1912. By C. O. Hawthorne. London: John Bale, Sons and Danielsson. Price 6s. net. Pp. viii and 441.

This is a volume chiefly of collected papers which have been published by the author from time to time in various journals; there are also a number of clinical lectures. Among the more interesting papers may be noted one on rheumatism, rheumatoid arthritis and subcutaneous nodules in which the author reports cases of rheumatoid arthritis which presented subcutaneous nodules indistinguishable from those found in rheumatic fever; from this he deduces that either the rheumatic nodule is not peculiar to rheumatic fever or that rheumatic fever and rheumatoid arthritis are different forms of the same pathological process. Another interesting paper is on pyrexia in gall-stones and liver diseases. In a third paper the author attempts to reconcile the different readings which are sometimes given by the sphygmograph and sphygmomanometer. His view is that when a sphygmograph tracing shows a sustained wave, followed by a sloping downstroke it means that the pressure within the artery only declines slowly, and this is not inconsistent with a low maximum reading on the sphygmomanometer, on the other hand, where the apex of the sphygmogram is sharp and the down stroke abrupt the pressure within the artery has declined rapidly though it might have been high at the beginning as shown by the pressure reading. The articles are written in a clear and interesting fashion and will well repay perusal; one finds in them many points derived from the author's own experience which are not usually dealt with, or, at any rate, not in the same fashion, in the ordinary text-books and monographs.

W. S. H.

TROPEN KRANKHEITEN UND TROPENHYGIENE. Ruge and Max zur Verth.

This is a well-written handbook on tropical diseases, of some 400 pages. Debatable questions are eschewed and the authors have in sight the needs of the practitioner resident in the Tropics. No references are given. The text needs revision in places. The article on Malta fever does not give a correct summary of what is now known on this subject. Moreover, the authors express an opinion that vaccination against enteric fever and plague is of doubtful value. The volume is well illustrated. C. B.

E. MERCK'S ANNUAL REPORT, 1911, Vol. xxv.

This is a record of recent advances in pharmaceutical chemistry and therapeutics. In this number excellent reports on the salts of glycerophosphoric acid, and on digitalis preparations are included. Under the heading "Mastic" we read :—

"Thomschke tested the mastic solution (20 grm. of mastic, 50 grm. of chloroform, 2 drops of linseed oil) suggested by von Oettingen, in a large number of surgical operations and wounds and expresses himself well satisfied as to its practical value. A mastic dressing is not only cheaper than other dressings, but is easier to apply and yet fulfils all the requirements of modern technique. . . . . The smallest possible quantity should be used in order that it may not soak through the gauze dressing. Haist first paints the neighbourhood of the wound with tincture of iodine and then with mastic solution, whereupon the wound is covered with sterile dressing. Voos uses the so-called 'Mastisol,' a solution of mastic in benzol, which is said to possess greater adhesive power. In all injuries, cuts, bullet wounds, contused wounds with ragged edges, and compound fractures, the neighbourhood of the wound is painted with mastisol up to the very edge of the wound, without regard to the degree of soiling and previous cleansing. By this means all the bacteria present on the skin are fixed and rendered innocuous. Very dirty wounds are freed from foreign bodies by means of forceps and a swab, after which the aseptic dressing is applied. This immediately adheres to the parts which have been painted and cannot be displaced. In the case of smaller wounds the dressing keeps in place without special methods of fastening with bandages."

This extract gives an indication of the great usefulness of this work of reference. C. B.

HEALTH AND EMPIRE. By Francis Fremantle. London: John Ouseley, Ltd. 1911. Pp. xii and 369. Price 7s. 6d. net.

"It seems to me best to approach the prevention of disease, not so much from the humanitarian as from the economic point of view."

In agreement with this quotation from Sir Ronald Ross the author explains that the aim of this book, as of the travels on which it is based, is to prove that health is a matter of business efficiency in imperial welfare.

In order to study these problems on the spot Dr. Fremantle spent eighteen months of 1903 to 1904 in visiting India and the Far East, returning by America. Though some years have elapsed since the tour here described, and though no reference is made to more than one triumph of preventive medicine in recent years, still many of the lessons

to be learnt from the book are as necessary now as when it was written.

The first winter was spent on plague duty in the Punjab, and a good description of the daily life is given. The author visited Colonel Semple at Kasauli, and Professor Haffkine at Parel. The results of his observations, here and elsewhere, are embodied in chapters entitled "The Mad Dog and the Flea."

His account of the work done at Kasauli is excellent, and the least scientific reader will understand the principles and practice of vaccine and serum treatment.

Passing from India to Malaya, he visited Singapore and Kuala Lumpur; the latter "an epitome of modern civilization," which affords him an opportunity for discoursing on the science of town making, as does the well-known Research Institute there on the ætiology of beri-beri.

Next, he went to the great Hôpital Militaire of Saigon, the Pasteur Institute of the Far East, and visited M. Yersin, who lives a day's journey up the coast.

Thence to Hong Kong, the kitchen of the plague, with a vivid description of the Chinese quarter in Victoria, which he regards as the cooking pot thereof.

By Shanghai to North China, which afforded glimpses of the war, and led to reflections on the aftermath. Then Japan, with observations on schools and public health, and an account of the Tokyo Institute of Infectious Diseases, under Professor Kitisato. A chapter on the Japanese Red Cross Society contains some sound remarks on the relation in which voluntary aid should stand to the medical work of an army.

Crossing the Pacific, he was shown the methods adopted for stamping out the plague in the Chinese quarter of San Francisco; he describes the extraordinary fight between Mayor Schmitz and his Board of Health.

The book is a plea for a wider outlook on the problems of preventive medicine, and in the final chapter are outlined administrative and educational provisions which should promote this.

Not merely must the public and our legislators be educated in such matters, but it is the unfortunate heritage of the medical schools that their study and teaching is, for the most part, limited to the narrow groove of corrective medicine as applied to man, the Englishman, in England. Though the author states that his book is written for general rather than professional consumption, it could be read with profit by every medical man who has never left these shores, and by many who have. As to the layman, he will find therein not merely a readable record of travel, but scientific matters dealt with in a very broad way, and problems of great interest discussed. J. T. C.

Manual for Women's Voluntary Aid Detachments. By P. C. Gabbett, M.R.C.S., Lieutenant-Colonel, I.M.S., retired. Pp. 95, and index. Price 1s. net.

The author has attempted to crowd too much into this small manual.

It would have been of greater value if the duties of a Women's Voluntary Aid Detachment had been more clearly defined and dealt with, and more space given to nursing duties.

There appears to be some confusion between the functions of the Field Ambulances of the Territorial Force, and the Voluntary Aid Detachments which are to take the place of the clearing and stationary hospitals which do not exist in the Territorial Force.

One would have imagined that the Women's Detachments would not have been nearer the firing line than the stationary hospital zone; but it appears that the author's view (from remarks on p. 51) is that Women's Detachments will be employed in Field Hospitals.

The diagram on page 9 is rather vague, and would appear to introduce a new transport problem, in addition to that already connected with the moving of the clearing hospital. W. J. L.

British Red Cross Society.—Nursing Manual No. 2. By James Cantlie. London: Cassell and Co., Ltd. 1912. Pp. xv and 207. Price 1s. net.

Nursing Manual No. 2 of the British Red Cross Society is written as a guide to suit the requirements of the members of the Voluntary Aid Detachments of the British Red Cross Society.

It does not claim to be a systematic work on nursing, but as a manual for an untrained "nurse" (male and female) it appears to be too elaborate, and enters too much into medical details.

Much space is taken up with a description of simple duties which might be left to the common sense of the individual, and in places the directions for the performance of practical nursing work are insufficient, while methods are advocated which are hardly up to the modern standard.

Simple and direct instruction and avoidance of profuse detail are preferable in the instruction of the members of these Detachment. The advertisement on the first page is likely to attract buyers from among the Women's Detachments. H.

Current Literature.

Hermann and Perutz Serum Reaction.—Porges found that syphilitic sera give precipitates when mixed with a watery solution of sodium glycocholate. Most experimenters, however, have obtained uncertain results with this method. Hermann and Perutz have thus modified the process (*Med. Klinik.*, 1911, No. 2).

They employ two solutions:—

(1)	Sodium glycocholate	2·0 grm.
	Cholesterin	0·4 ,,
	Alcohol, 95 per cent	100·0 ,,
(2)	A freshly prepared 2 per cent watery solution of sodium glycocholate.	

The serum is inactivated by heating to 55° C. for half an hour; 0·4 c.c. of serum is mixed with 0·2 c.c. of (1) solution diluted with 19 times its bulk of distilled water, and 0·2 c.c. of (2) solution is added. The mixture is shaken vigorously, and is allowed to stand at laboratory temperature for twenty hours, when a precipitate of large or small

flocculi appears in specific sera. In only one of 89 non-syphilitic sera did a positive reaction occur; 108 of 134 syphilitic bloods answered to the test; 102 of these were examined by Wassermann's method, of which 72 were positive; 76, however, were positive to Hermann and Perutz' test.

Jensen and Feilberg (*Berl. klin. Woch.*, June 3, 1912, p. 1086) examined 63 non-specific sera by this process. They all re-acted negatively. The sera of 30 persons in whom syphilis was latent, were negative both to Wassermann and to the above-described method. The sera of 60 patients who were showing signs of syphilis were tested, 43 were positive and 17 negative. The Wassermann reaction was positive in all in which it was employed, 55 in number. Hence the Hermann-Perutz test is not so delicate as the Wassermann. The authors consider that a positive response is diagnostic of syphilis, but a negative reaction does not exclude the infection. The Wassermann test should be applied to such sera.

Gammeltoft (*Deut. med. Woch.*, October 10, 1912, p. 1934), following Hermann and Perutz technique, has made 200 examinations of the blood of 156 patients; 84 sera negative to Wassermann were negative to Hermann and Perutz; 49 positive to Wassermann were positive to Hermann and Perutz; five cases with a history of lues were positive to Hermann and Perutz, though negative to Wassermann. In three the contrary occurred. In only one instance (cancer of the liver) was a positive reaction observed with a non-luetic serum. Gammeltoft thinks that the method is worthy of trial on account of its simplicity.

C. B.

Wassermann Reaction.—Hahn (*Berl. klin. Woch.*, December 2, 1912, p. 2340) reports that 85 per cent of 1,200 syphilitic patients gave a positive reaction, six to twelve months after the disappearance of the last signs. A year later 82 per cent were still positive. Hahn says it is irrational to continue specific treatment until the serum reaction has become negative. He thinks, too, that it is bad practice to administer salvarsan in latent syphilis solely because the blood-reaction is positive.

C. B.

Chemical Examination of Cerebrospinal Fluid.—To obtain the Nonne-Apelt reaction, 1 c.c. of cerebrospinal fluid is mixed with a saturated watery solution of ammonium sulphate. In cerebrospinal syphilis a turbidity appears in a few minutes time, and a flocculent precipitate is deposited in twenty-four hours. In some normal fluids slight opacity may be observed, and in early specific cases the reaction may be negative. Lange (*Zeitschrift fur Chemotherapie*, I., i., p. 44) tests the cerebrospinal fluid with colloid gold prepared according to Zsigmondy's method; 120 c.c. of pure distilled water are heated to boiling point in a Jenner flask; 25 c.c. of potassium chloraurate solution prepared by dissolving 6 grm. of "aurum crystallatum," Merck ($AuCl_4H.3H_2O$) in 1,000 c.c. of water containing 3 or 3·5 c.c. of 0·18 normal solution of pure potassium carbonate, are added. The flame is removed, and 3·5 c.c. of a dilution of 0·3 c.c. of formalin to 100 c.c. of water are poured in.

Under vigorous shaking the pale rose colour is soon transformed into the deep purple of the colloid gold. This colloid gold solution is a very delicate test for organic impurity of water. Hence special precautions must be taken in distillation, and in ensuring the purity of all vessels. Electrolytes precipitate colloid gold. If, for instance, a little sodium chloride be added, the fluid becomes colourless in the course of a few hours, the gold having been deposited as a black layer on the bottom of the vessel. Zsigmondy found that the presence of albuminous bodies prevents this precipitation, and that the action is quantitative. Each protein has a different value. Hence colloid gold is a means of their identification. A ten-fold dilution of the cerebrospinal fluid is made in 0·4 per cent sterile salt solution. From this 20·, 40-, 80-, &c., to 40,000 fold dilutions are prepared. One c.c. of each of these is placed in a tube, and 5 c.c. of the colloid gold fluid is added. The tubes are shaken. The results are noted next morning. Normal cerebrospinal fluid, if unmixed with blood, leaves the gold quite unchanged in all dilutions. Pathological cerebrospinal fluids precipitate the gold. The original purple-red colour is changed successively to lilac, dark blue, light blue, and at last, if the precipitation is complete, the fluid becomes colourless. It is a curious fact that this does not occur with the lowest dilutions. For example, in a case of incipient tabes, the 1 in 10 remained unchanged; the 1 in 20 was bluish red; the 1 in 40 light blue; the 1 in 80 colourless and clear, hence the reaction was complete; the 1 in 160 slightly blue; the 1 in 320 lilac; and so on. All the dilutions above 1 in 2,560 were unchanged. The strongest reactions occur in cerebrospinal syphilis, tabes, and general paralysis; that is, in cases in which the fluid gives a marked Wassermann response. Lange has examined the cerebrospinal fluid of manifest and latent syphilis in which the test was negative. He believes that it indicates a localization of the spirochætes in some part of the central nervous system. If this be correct, then that system is implicated in the early stage of syphilis much more frequently than is supposed. If headache is present the reaction is almost always positive. The presence of blood or pus in the cerebrospinal fluid changes the colloid gold, but the precipitation takes place only in the highest dilutions, 1 in 2,000, to 1 in 20,000, which distinguishes it from a specific reaction.

C. B.

Human Trypanosomiasis in Nyasaland (*Sleeping Sickness Bulletin*, No. 39, vol. iv, August, 1912).—The first case of human trypanosomiasis in Nyasaland was found in the West Nyasa District in October, 1908; 60,000 natives were then examined, but no infected persons discovered. In December, 1908, Captain Hardy, R.A.M.C., one of the medical officers who made the inspection, fell a victim. He believed that he contracted the disease near Lake Nyasa. Since then forty-seven cases have come to notice. The trypanosome concerned is *Trypanosoma rhodesiense*, which is a distinct species nearly related to *T. Brucei* and *T. gambiense*. It is transmitted by *Glossina morsitans*. The incubation of the human malady is seven to fourteen days. The course is more severe and rapid than the *T. gambiense* infection. The clinical picture of sleeping sickness is wanting. Salvarsan was used in five advanced cases without benefit. Atoxyl and soamin also failed

to cure. The difference in the habits of *G. palpalis* and *G. morsitans* modifies preventive measures. Palpalis haunts narrow belts near water. Morsitans migrates over large tracts of country.

The virulence of *T. gambiense* strains and human trypanosomiasis in Brazil are also subjects of interest reviewed in this Bulletin.

C. B.

Plague.—In the *Bulletin Office International d'Hygiène Publique* for September, 1912, there is a concise summary of recent work on plague, the outcome of the Manchurian epidemic. This outbreak began in November, 1910, and subsided in March, 1911. More than 40,000 persons perished. The fatality was 100 per cent. Starting from the north of Manchuria, it extended east and south, chiefly along the lines of commerce. The disease was of the pneumonic form exclusively. In fact, the distinction between it and pneumonia could be made only by a microscopical examination of the sputum. Its incubation period was two to five days. The cultures of the plague bacillus of these pneumonic cases resembled those of bubonic plague of other parts of the world, and induced the bubonic disease when inoculated beneath the skin of animals. Animals succumb to pneumonic plague if emulsions of the bubonic bacillus are introduced into their respiratory passages.

Dr. Wyzniekiewitsch infected himself in the plague laboratory of Kronstadt with a growth of the bubonic bacillus. He died of plague pneumonia.

Another worker in the same laboratory, Dr. Schreiber, succumbed to the pneumonic form, contracted by sucking up the contents of a pipette filled with a similar culture. Dr. Padlewsky cut his finger while performing the autopsy of the latter. An axillary bubo was the result.

Zabolotny pricked himself with the needle of a syringe which contained fluid aspirated from a lung of a pneumonic plague cadaver. Two days later he suffered from a bubo in the armpit and fever. Thereupon he received an injection of 70 c.c. of anti-plague serum. He recovered. The plague bacillus of Manchuria, however, was more virulent than other strains. The virulence was not destroyed by a night's exposure to a temperature of $-30°$ C. The micro-organism has been recovered from corpses a year after interment in parts where the ground is frozen for many months. This is an important epidemiological fact, for the marmot which inhabits these districts, known in Siberia as the tarbagan, is sometimes carnivorous, and may be infected by feeding on a plague cadaver. Rats played no part in the Manchurian outbreak.

Andrew examined 3,000 rats (*Mus decumanus*) from the north of China. None were infected. More than 30,000 from the south of Manchuria were also free from plague. Six per cent of these were *Mus rattus*. Of recent years hunting the tarbagan has been a great source of profit on account of the enhanced value of its skin. Towards the third week in October, 1910, 10,000 tarbagan hunters were congregated at Manchuli and Khailar. The first case of pneumonic plague arose among these men at Manchuli on October 12, 1910. Twenty days later the disease declared itself at Kharbin among those who were returning to their homes. At this time of year the thermometer falls 40° below

zero; hence the people crowd together in the smallest possible space to ensure warmth. Now plague pneumonia is spread by the droplets of saliva and sputum ejected in the form of spray by the patient when he coughs or speaks. Zabolotny placed agar plates at a distance of half to one metre from a pneumonic plague patient who was coughing. Numerous colonies of *Bacillus pestis* developed. Martini caused rats to inspire an emulsion of infected rat liver in the form of a spray. They succumbed to plague. Zlatogoroff found living plague bacilli in sputum which had been dry for three weeks.

Hence those in close association with persons suffering from plague pneumonia must receive plague bacilli into their respiratory passages, unless these are protected by the use of a veil over the nose and mouth.

To recapitulate, the epidemic had its origin in an epizootic of plague in the tarbagans. The hunters became infected while skinning these diseased animals. It assumed the pneumonic form in these men. The dense overcrowding and total absence of ventilation in their winter dwellings explain the frightful rapidity with which the scourge spread from man to man. The domestic animals also contracted plague. A donkey and nine mules died of plague pneumonia. Three persons who had charge of them were attacked with fatal pneumonic plague. Horses, pigs, and dogs are said to have been infected. Klodnitzky thought that the camel is susceptible to the malady, and that it is able to transmit the disease to man. Schurupoff's experiments throw doubt on this. The three camels which he tested were quite refractory to very large quantities of plague cultures. The hibernating marmot acts as a reservoir of the plague bacillus. Du-Jardin-Beaumetz and Mosny find that this animal during its winter sleep may live one hundred and fifteen days before dying from the infection. This may be the reason why there are endemic areas in Mongolia and Astrachan, where these rodents occur.

It is possible that there are human plague carriers. Christie reported a case of a woman, who, though in good health, appeared to give the disease to her relatives.

Inoculation with anti-plague vaccine is not of so great prophylactic value against pneumonic as against bubonic plague. At the Plague Conference at Mukden, Fang-Chin reported 4 deaths from pneumonic plague in 439 inoculated. Uyama inoculated 1,923 soldiers. No cases occurred among them. Kasai observed eight attacks in 2,832 people inoculated. Worrell treated 80 persons with vaccine. They all escaped. Seven deaths from plague were recorded by Bogski in 8,865 inoculated. Haffkine injected a mixture of his prophylactic and anti-plague serum beneath the skin of 132 people at Kharbin; 22 contracted plague and died; 10 of these, however, were tuberculous. Prophylactic injections of anti-plague serum seemed effective in warding off the disease in four out of five people who had been exposed to infection by sleeping in the same room as a patient. The curative action of the serum in the Manchurian outbreak was not noted in any cases. According to Strong, when plague bacilli are present in the sputum, the time has passed for its administration.

At the beginning of the epidemic several physicians lost their lives from plague pneumonia. After Strong and Teague had shown that a veil of gauze covering the nose and mouth prevented the access of the

spray, scattered by the patient, to the respiratory passages of the attendant, and this precaution was adopted; the incidence among the hospital staff became much lessened. The patient should also wear a veil of three thicknesses of gauze, which must be kept dry. If it is moist it no longer arrests the droplets of sputum and saliva disseminated while coughing, &c. C. B.

Poliomyelitis transmitted by Stomoxys Calcitrans.—Rosenau (*Public Health Reports*, September 27, 1912, vol. xxvii, No. 39, p. 1593), allowed a number of the blood-sucking flies, *Stomoxys calcitrans*, to feed on monkeys suffering from anterior poliomyelitis in its various stages. He then caused these flies to bite healthy monkeys at different intervals. Six of these animals contracted the disease. The virus of anterior poliomyelitis appears to undergo elaboration in the stomoxys, for some period, less than twenty-one days, must elapse before the flies are capable of transmitting the infection.

C. B.

A Study of the Gases of Emmental Cheese.—William Mansfield Clark, Ph.D. (United States Department of Agriculture, Bureau of Animal Industry, 151, 1912) states it is well known that the "eyes" or cavities of Swiss or Emmental cheese are its chief characteristics, and that their size and spacing determine to a large extent the commercial value of the cheese.

To the biological chemist the subject is of great interest, because of a supposed localization of reactions generating considerable quantities of gas, and because of the production of a plasticity among the colloids of the cheese, which makes possible the peculiar mould formed in the cavities.

The experimental work described in this bulletin is concerned with the investigation of the gases which are immediately concerned in the process of the eye formation.

The method adopted of collecting the gases from the cavities is very ingenious, and briefly consists of a glass cylinder into which samples of cheese taken by a trier are introduced, the cylinder being connected to a mercury vacuum pump. The gases are then pumped from the cheese and delivered into the cylinder. The method is illustrated by a very clear diagram.

The author summarizes his results as follows:—

(1) The normal "eyes" in Emmental cheese are produced exclusively by carbon dioxide and nitrogen, and of these only the carbon dioxide is of significance.

(2) The nitrogen accompanying the carbon dioxide in normal eyes is that of air originally occluded in the curd at the time of manufacture.

(3) There sometimes occurs during the initial fermentation an evolution of gas characterized by the presence of hydrogen. This is believed to be due to the gaseous fermentation of sugar.

(4) The hydrogen from such an initial fermentation may sometimes linger to contaminate the gas of normal eyes.

(5) The two fermentations are distinct and are characterized by their

gaseous products. The one is detrimental, the other that demanded of a good Emmental cheese.

(6) High oxygen-absorbing power combined with low permeability of the cheese to air renders the interior thoroughly anaerobic, and consequently favourable to the growth of anaerobic bacteria.

(7) A comparison between the amount of carbon dioxide evolved and the total volatile fatty acids shows that the activity of the propionic bacteria of Von Freudenreich and Jensen is not sufficient to account for all the carbon dioxide found.

(8) It was found that cheese is capable of retaining a very large amount of carbon dioxide.

(9) The possibility is suggested that there are two phases in the formation of normal eyes; a saturation of the body with carbon dioxide and an inflation of eyes. The bearing of this hypothesis on the production of gas by a specific cause is discussed.

W. W. O. B.

Purification of Water by the Darnall Filter.—Lieutenant-Colonel Reichelderfer, Chief Surgeon, N.G.D.C. (*Military Surgeon*, September, 1912) gives an interesting sketch of the application of this method of purifying water in camp. The water-supply was derived from a main, but was found to be highly contaminated. A battery of Darnall filters was constructed as follows:—

Twelve empty whisky barrels were placed on the upper platform of a scaffold frame, on the middle platform immediately below the barrels a row of Darnall filters was placed, and on the lowest platform a row of whisky barrels for storage purposes. From the main the water was run by hose into the upper tier of barrels where alum was added and the water allowed to settle. A small pipe opening six inches above the floor of the barrel drew off the water into the Darnall filter, from which it was run into the storage barrels. The sediment from the upper barrels was drawn off by a hose and run into a soakage pit. A trained orderly and four fatigue men supervised the working of the plant, which could have supplied 3,500 to 4,000 men. The cost was about £21.

C. E. P.

Crude Carbolic Acid as a Larvicide. — Wise and Minett (*Journ. Trop. Med. and Hygiene*, December 2, 1912) report very favourably on the use of crude carbolic acid as a larvicide for pools which cannot be drained and are too small to be stocked with fish. They used one teaspoonful to each two cubic feet of water, which gives a strength of approximately 1 in 16,000; this was found sufficient to kill all larvæ and pupæ in three hours, without giving rise to the risk of poisoning cattle, as $12\frac{1}{2}$ gallons of water only contained 1 drm. of the acid. Crude carbolic acid was found to be more efficient as well as cheaper than the purified acid.

C. E. P.

Motor Ambulance Wagons for Bulgaria.—The *Allgemeine Automobil-Zeitung* (No. 49, of December 8, 1912), states that Bulgaria had ordered ten 20 h.p. motor ambulance wagons from the Daimler Company, for immediate delivery.

The chassis is of the one-ton Daimler general utility type; the engine has four speeds and a reverse, the maximum speed on a fair level road is 20 miles per hour. The front wheels have pneumatic tyres and the back ones solid rubber tyres. The motor power is supplied by benzine, the consumption of which is calculated to be roughly 4½ gallons for 65 miles; the reservoir has a capacity of 90 litres (nearly 20 gallons). The wagon is fitted with acetylene lights and also paraffin lamps. A supply of drinking water is carried in a tank. The wagon carries four stretchers, these are made of tubular steel and canvas and have specially designed springs. The wagon can carry four lying-down patients or four sitting-up and two lying-down. The sides are covered in with canvas curtains which can be rolled up.

C. E. P.

The Care of the Wounded. — Lieutenant-Colonel Boissonnet (*Revue Milit. Gén.*, July and August, 1912) gives a sketch of the medical arrangements and the condition of the wounded immediately after each of the principal battles during the war of 1870, and concludes that, in spite of the advance in scientific knowledge, the wounded were not so well looked after in 1870 as in 1806 and 1807. This was entirely due to the faulty medical organization. After the battle of Wörth the surrounding villages had from 200 to 4,800 wounded in each. All kinds of buildings, even stables and sheds, were crowded with wounded; but in many cases it was impossible to find any kind of shelter, and many of the wounded had to be left in the open. Dressings were deficient, and there was no food left in any of the villages. Some nourishment was obtained for the wounded by using portions of the horses killed in action. To add to the misery a heavy thunder storm broke during the night and drenched the wounded, even those under cover, as all the roofs had been more or less damaged during the fighting.

The conditions after the other battles were quite as bad, or even worse, than after the battle of Wörth. The number of medical officers and orderlies was insufficient to attend to the masses of wounded; dressings and blankets were everywhere deficient; the only transport available consisted of springless country carts with some straw on the floor. The wounded had to be packed into all available buildings, but the greatest suffering was caused by the impossibility of obtaining any kind of nourishment for the wounded.

Boissonnet then goes on to point out that in a future war the same aggregation of wounded is to be feared, with similar suffering and disastrous results. He insists on the necessity of having a well-organized system of transport, so that all wounded who can be moved may be sent off to a distance as soon as possible. Boissonnet says that the French army only possesses 50,000 stretchers, and that at least 200,000 should be provided, as he estimates that it will be necessary to evacuate this number of sick and wounded during the first month of hostilities. He thinks that a sick or wounded man once placed on a stretcher should not leave it till he reaches a bed in a properly equipped hospital. Each medical unit which admits a patient on a stretcher should issue a stretcher to the conducting party which brought the patient. A stretcher once used for a patient will not be available for re-issue for some time, probably a month, as it must be thoroughly cleaned and disinfected.

Only a few permanent hospital trains are available, and Boissonnet thinks that owing to the number of supply and ammunition trains which must be sent up even the "trains sanitaires improvisés" will not be forthcoming, so that the evacuation of wounded will have to be carried out by empty supply trains returning to the base.

General de Lacroix adds a note in which he concurs in Boissonnet's views and says that the number of hospital beds is quite insufficient. Including those provided by voluntary aid societies there are only some 30,000 available for the army in France, while he says at least 200,000 will probably be required.

C. E. P.

The Influence of Certain Camp Epidemics upon the Geographical Expansion, Political History and Military Policy of the United States.—Under the above title, Major E. L. Munson, Medical Corps, U.S.A., read an excellent paper at the Twenty-first Meeting of the Association of Military Surgeons (*The Military Surgeon*, November, 1912). He began by pointing out that the influence of camp disease upon military operations, as demonstrated in practically every conspicuous and momentous period of the world's history, has unquestionably never been clearly or fully understood, and has received little if any serious consideration from the standpoint of its military, political and national significance. Historians usually pass over the existence of epidemic diseases with merely a brief mention, and do not lay stress on the fact that in many cases the military weakness which influenced the commander's plans was the result of preventable disease.

He then briefly referred to a number of historical examples, e.g., the destruction of the Assyrian host under Sennacherib, which saved the Israelites; the dysentery which ravaged the armies of Xerxes and largely helped to save the Greeks; the typhus fever which forced the Spanish to abandon the siege of Metz in the sixteenth century; the cold which destroyed Napoleon's Grand Army in Russia.

The two campaigns which were decided by preventable disease and which exercised an immense and far-reaching influence on the future of the United States, were the Quebec expedition and the destruction of Napoleon's veterans in San Domingo.

The invasion of Canada was one of the earliest strategic moves in the war of the Revolution. Canada at the time only had a garrison of some 550 men; the French Canadians were not expected to make any resistance, while reinforcements could not be sent from England till the following spring.

Benedict Arnold was given command of a force of roughly 1,100 men and set out from Boston on September 21, 1775, with the idea of surprising Quebec, which had no garrison, but contained a large supply of war stores. On October 12, the force, through disease and exposure, was reduced to 950. Smallpox and dysentery attacked the force and obliged Arnold to halt and to send back a large number of sick with a strong escort. Only 510 men arrived in front of Quebec and these were in rags. Arnold's advance had also become known and Quebec had been placed in a fair condition to resist attack. The result was that the attack was repulsed. Thomas, who had assisted in capturing Montreal, arrived before Quebec

with only 700 efficient men and 900 sick out of a force which had originally numbered 5,000. The garrison of Quebec made a sortie and obliged him to make a hurried retreat, abandoning many sick and most of his stores. This ended the invasion of Canada. Had the American troops been healthy nothing could have prevented them from capturing Quebec and with it the whole of Canada.

Immediately after the peace of Amiens in 1802, Napoleon, wishing to establish a French Colonial Empire in the West, collected 20,000 veteran troops and despatched them to San Domingo, with the intention of annexing this island and then occupying Louisiana, in order to obtain possession of the mouths of the Mississippi, which had been ceded to France in 1800 by Spain. This force quickly subdued San Domingo and was about to move on to Louisiana when yellow fever appeared among the troops. Twenty generals died at once and the soldiers perished in thousands. A reinforcement of 10,000 men suffered most severely. Fifteen thousand men died in two months, and the survivors were unfit for active service. Being unable to hold Louisiana and fearing to lose it to the English, he sold it for £3,000,000 to the United States, which thus doubled its territory. The dream of founding a French-American Colonial Empire was thus shattered by an epidemic of yellow fever which ought to have been foreseen and might, even at that time, have been to a certain extent prevented.

C. E. P.

Paper Negatives for X-ray Pictures.—Stabsarzt Dr. Hufnagel (*Deutsch. militärärzt. Zeit.*, October 20, 1912) recommends bromide paper instead of plates for taking X-ray pictures. The exposure should be increased by about one half, as the paper is not quite so sensitive as a plate. The paper is used in exactly the same way as a plate, but is not quite so easy to manipulate. Paper has the advantage of being lighter, unbreakable and cheaper than plates.

C. E. P.

Fitting of Boots in the United States Army.—General Order, No. 26, August 16, 1912, gives very full directions as to how soldiers' boots are to be fitted. When being measured the soldier is to stand bare footed, with a 40 lb. load on his back and bearing the entire weight on the foot which is being measured. The length of the foot is taken by the usual form of sliding scale and 2 is added to obtain the size length of the boot. The circumference of the foot at the base of the great toe is next taken, and the result is referred to a table which shows the corresponding width of boot. The selected boot is then put on, tightly laced up and the soldier, carrying a 40-lb. load, bears his whole weight on each foot in turn. The fitting officer is then directed to press on the leather of the upper and to see that there is not less than ¾ in. of unoccupied space in front of the toes and that the leather does not wrinkle. A record of the proper size for each man will be kept. Special boot stretchers with adjustable knobs are supplied for fitting men who have bunions. If the boots are not quite comfortable they are to be wetted and then worn for an hour's walk. When taken off a little neat's-foot oil is to be rubbed into the leather to prevent its hardening and cracking.

C. E. P.

The Establishment of a Voluntary Aid Hospital.—Kom. Rat. Wildhagen (*Das Rote Kreuz*, October 13, 1912), President of the Kitzingen Branch of the Bavarian Red Cross Society, read a paper showing the difficulties which may be encountered when attempting to establish a Red Cross hospital on the outbreak of war. The Kitzingen branch had made certain preparations, and its Committee had reported to the Central Committee that they were prepared to open a hospital of thirty-five beds on the tenth day after mobilization. During 1911 the Committee decided to equip the hospital and get it ready for the reception of patients. Wildhagen was entrusted with the arrangements. On going into the matter he found that the bedding in store was insufficient, that funds were wanting, and that none of the contractors who had agreed to supply necessary articles could do so in the time specified. Wildhagen points out in his paper that the actual state of preparedness was very different to what the Committee believed it to be, and that in case of war, when railway traffic would be disorganized, it would be impossible to make up for lost time. In this case he was able to collect the necessary funds and equipment, but could not report the hospital ready for the reception of sick till long after the time fixed.

C. E. P.

Army Nursing Sisters in the German Army.—A press notice (*Der Tag*, November 28, 1912) states that during 1913 six nursing sisters are to be appointed. For the Prussian Army it is intended to have an establishment of sixty nursing sisters. In 1907, twenty were appointed at a salary of £20 a year. In 1908, sixteen were appointed and the salary was raised to £34 10s. with a grant of £7 10s. for outfit on first appointment. An increase in the establishment will probably be sanctioned next year. The introduction of nursing sisters has been followed by most satisfactory results in regard to the care of the sick.

C. E. P.

Correspondence.

REPORT ON THE METHOD OF FIXING DRESSINGS FOR DEEP SUTURES.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—With reference to the article under the above heading published in the November Journal, I would venture to suggest that the following method, which has been in use in this Hospital for the past four years, is not only equally efficacious but at the same time simpler and quicker. It has the additional advantage of being applicable to any part of the body, which the method described apparently has not. The following is the method used here: The various layers are sutured in the ordinary way, and then a continuous subcuticular silk-worm gut suture is inserted

with the ends left long. A pad of gauze is then applied over the wound and the two ends of the suture tied together over the pad, or if necessary the ends may be passed through the pad. For those who use the "no further dressing" method, this is sufficient, and the patient may be returned to bed without any fear of the dressing slipping.

This method obviates the introduction of adventitious sutures with their attendant risks of infection, to say nothing of the resulting scars which, although trivial, in certain parts of the body might be unsightly. Another advantage of this method is that the resulting scar is but a thin line, which in many cases becomes quite indistinguishable from the surrounding tissues in a few months.

I am, &c.,

Kasauli,
December 23, 1912.

A. J. Wells,
Capt. R.A.M.C.

No. 3. March, 1913. Vol. XX.

Journal

OF THE

Royal Army Medical Corps

J. J. Fotheringham
Toronto

EDITED BY

COLONEL W. H. HORROCKS,

ROYAL ARMY MEDICAL CORPS

ASSISTED BY

MAJOR C. E. POLLOCK,

ROYAL ARMY MEDICAL CORPS

ISSUED MONTHLY

IN ARDUIS FIDELIS

Printed and Published by

JOHN BALE, SONS & DANIELSSON, LTD.

OXFORD HOUSE,

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W.

Price Two Shillings net.

VOLUME XX. MARCH, 1913. No. 3.

Journal of the Royal Army Medical Corps.

Original Communications.

ARCHIBALD ARNOTT, SURGEON, 20TH FOOT.

BY MAJOR E. B. STEEL.
Royal Army Medical Corps.

ARCHIBALD ARNOTT, M.D.Edin., 1815, joined the Army as Surgeon's Mate of the 11th (Light) Dragoons on April 14, 1795, and became Assistant Surgeon of that regiment on December 25, 1796. He was promoted surgeon of the 20th Regiment of Foot on August 23, 1799, and remained in that regiment during the rest of his service. He proceeded to Holland with the Corps, was present at the storming of the entrenchments of Krabbendam, and at both the actions fought at Egmont-op-Zee.

His next service was at Minorca, thence he went to Egypt, and was present at the storming of the Forts at Alexandria. On the reduction in 1802 of the regiment by one battalion, Dr. Arnott was placed on half pay, but was restored to the active list in the 1st Battalion on May 17, 1803. He served with his regiment in Malta, Sicily, Calabria, and was present at the Battle of Maida. He was with the regiment in Portugal, being present at the Battle of Vimiera, and in the retreat on Corunna.

After a brief stay in England he accompanied the 20th on the Walcheren Expedition, where the Corps was decimated by fever, from the effects of which the regiment required two years' home service to recover. In 1812, Dr. Arnott again accompanied his regiment to Portugal, serving in Lord Wellington's campaigns

until the end of the war, including the Battle of Vittoria, all the actions in the Pyrenees in which the 20th took part, and the battles of Nivelle, Nive, Orthes, and Toulouse. The regiment served in Ireland from 1814 to 1819, embarking for St. Helena in the latter year. Here occurred the most remarkable and eventful incident of Dr. Arnott's career. This was his professional attendance on the Emperor Napoleon during his last illness. He was called in to see the Emperor (having been previously consulted by Professor Antomarchi, the Corsican physician) about half past ten on the night of April 1, 1821. The room was perfectly dark, and he could barely distinguish the form of Napoleon as he lay on his camp bed. From this date he daily saw the Emperor, who always conversed with him in a friendly and affable manner. On April 14, Napoleon presented the "Life of Marlborough," through him, to the officers of the 20th; and on the 19th he made his celebrated denunciation of the British Government. Arnott's professional ability, together with his kind and gentle manner, soon secured for him the full confidence of Napoleon. The good opinion of his illustrious patient was strengthened by the daily interviews, and ripened into warm, personal attachment and sincere esteem, which were reciprocated by Dr. Arnott. A few days previous to his death, Napoleon gave a very interesting testimony of his respect for Dr. Arnott. He desired that a valuable gold snuff-box might be brought to him, and having with his dying hand, and last effort of departing strength, engraved on its lid with a penknife the letter "N," he presented it to him. On May 3, he gave instructions that should he become insensible no English physician but Arnott was to touch him Dr. Arnott was present at the death of Napoleon, which occurred at forty-nine minutes past five in the afternoon of May 5, 1821. The Emperor bequeathed to Arnott the sum of 600 napoleons, and the British Government granted to him a gratuity of £500.

Surgeon Arnott went with his regiment from St. Helena to India in 1822, and returned to England in July, 1826. On December 25, following he was placed on the retired list at 15s. a day, having completed thirty years' service, twenty-seven of which were passed in the 20th.

The following particulars of Dr. Arnott's life subsequent to his leaving the regiment are taken from the obituary notices which appeared in the daily papers at the time of his death. Dr. Arnott was almost the last survivor of those whose names will be handed down to posterity in connection with the last days of

Napoleon, and he had a rich fund of recollections and anecdotes of the period. These would have been read with interest, but except a clear and distinct account of the last illness, decease, and post-mortem appearances of Napoleon published in 1822, he could never be induced to commit them to print, being reluctant to mingle publicly in the keen and painful controversy of the time, although never concealing his own opinion in private conversation. From the sphere of public duty Dr. Arnott retired to his native parish, and there, on his patrimonial estate of Kirkconnel Hall, spent the evening of his days beneficially to the neighbourhood and honourably to himself, universally respected for his exemplary conduct in private life, and for the attention with which he discharged the duties of a magistrate and landlord. He sought in all ways to be useful to the community, his overflowing kindness, amiable manners, and readiness at every call to exert, gratuitously, his professional skill for the relief of the afflicted endearing him alike in the halls of the rich and in the cottages of the poor. Few men have enjoyed a larger share of the affection and esteem of their contemporaries, or have left behind them a more pleasing impression upon the minds of survivors. Dr. Arnott died at Kirkconnel Hall, Dumfriesshire, on July 6, 1855, in the eighty-fourth year of his age.

THE PHYSIQUE OF THE INDIAN ARMY: AN APPRECIATION.[1]

BY COLONEL R. H. FIRTH.

ALTHOUGH success in war depends more on moral than on physical qualities, still every officer must admit the importance of having men at his disposal of as high a grade of physical fitness as can be obtained. The principle is so well recognized that the State, in selecting its raw material out of which it means to make soldiers, demands that these recruits must be of trustworthy physique and sound constitution; further, as a part of the military education, the State subjects its selected material to a course of physical training. Recently, a large amount of data relating to the height, weight, and chest measurement of young soldiers of the Indian Army has passed through my hands. Much of my spare time during the spring and summer of 1912 has been devoted to the analysis of this material. True, it has been an arduous task, but the results are sufficiently interesting to deserve publication. For permission to publish thanks are due and given to the Adjutant General in India, through whose office at Army Headquarters the material was made available and placed at my disposal at the end of 1911.

The facts relate to 5,676 men of the Indian Army, each one of whom had approximately six months' service. As can be readily understood, there are represented among this number considerable diversities of race and caste, so much so that difficulties were experienced in grouping them. As presenting the greatest information with the least trouble the material has been classified into thirteen groups. This arrangement is to some extent arbitrary, but, for obvious reasons, it was impracticable when dealing with so much data to adhere to all the subdivisions into which the men can be subdivided. The following explains briefly the principle upon which the classification has been made. The term Pathan includes Mahsuds, Waziris, Afridis, Yusufzais, Orakzais and all the various classes usually referred to as Pathans; under Hazaras are included only those from the trans-frontier district near Ghuzni; the term Sikh includes Jats, Khattris, Labanas and Muzbis; among Baluchis are included Brahuis; under the head

[1] Received for publication October 19, 1912.

of Punjabis are Musalmans and Hindus of the Punjab, also Ahirs of the Cis-Sutlej area and Jats who are not Sikhs from the same district; under Hindustanis are included Brahmans of the United Provinces and Oudh, also ordinary Hindus and Jats and Musalmans from the United Provinces, Oudh, Behar and Orissa; the Rajputs include all the Rajputs, whether from Rajputana, the Punjab, United Provinces, Behar or Orissa; the Rajputana Hindus include Gujars, Jats, Bagris, and all Hindus not pure Rajputs, with them are grouped a few Rajputana Musalmans; the Dekhani Musalmans and Mahrattas include those from the Konkan; the Dogras, Garwhalis and Gurkhas are self explanatory; under Madrassis are Tamils, a variety of non-Tamil Hindus, all the Musalmans, Christians and Pariahs.

The actual numbers belonging to each of these classes or groups, and as to which precise physical data have been available, are shown in the following statement:—

Sikhs		1,104
Pathans		566
Hazaras		69
Baluchis		57
Punjabi Musalmans	746	766
,, Hindus	20	
Hindustani Musalmans	355	
,, Hindus	122	815
,, Jats	338	
Rajputs		369
Rajputana Hindus and Musalmans		81
Dekhani Mahrattas	221	265
,, Musalmans	44	
Dogras		228
Garwhalis		69
Gurkhas (Magars)	340	
,, (Gurungs)	376	
,, (Khas and Thakurs)	44	
,, (Limbus)	14	1,093
,, (Rais)	31	
,, (Other kinds)	288	
Madrassis (Hindus)	42	
,, (Musalmans)	20	
,, (Christians)	39	194
,, (Tamils)	67	
,, (Pariahs)	26	
Total		5,676

Primarily, the data were analysed with a view to determine the body weights which correspond to different ages and heights, in association with varying chest girths. The schedules of measurements, however, represented so many diversities of type that it was

soon realized that any formulations made on a basis attempting to show correlation between height and weight, age and weight, or chest girth and weight, would be largely arbitrary and involve serious fallacies, when applied to not inconsiderable sub-groups of the large classes. Therefore, as being likely to be misleading if applied as a subsidiary aid for examining and enlisting recruits, it was deemed wiser not to attempt the preparation of tables showing even apparent correlations between weight and age or between weight and height. The data, however, do justify the formulation of a general rule which may be of service to medical and recruiting officers. The rule runs as follows: "For men of between 18 and 20 years of age, taking 5 ft. in height as equivalent to 100 lb. in weight, for every inch above 5 ft. add 3 lb." Thus, a young man of 65 in. in height should weigh 115 lb., and one 68 in. in height should scale at least 124 lb. This rule, as given, is applicable to all classes. If anything, it is somewhat easy on the Hazara from Ghuzni, the Pathan, the Baluchi, the Sikh, and the Punjabi Musalman, in whom a ratio of 3½ or even 4 lb. for each inch of height above 5 ft. would work out fairly well. However, the rule, as enunciated, will give a sufficiently accurate, though rough, standard for weight to meet all requirements; it will eliminate the very unfit and not exclude the promising young man who may be a bit spare and run down when he presents himself for enlistment. Beyond this, it is unwise even to generalize.

Having arrived at these conclusions as to the object, for the determination of which the collection and examination of the data was undertaken originally, it seemed desirable not to waste the material, but rather analyze them on other lines. A suggestive line of inquiry seemed to lie in the application of Pignet's factor of physical fitness to the data available. Pignet is a French military surgeon who has devoted attention to various anthropometric questions presented by the men joining and serving in the Army of the Republic. In the course of his investigations, he evolved an empirical factor which he regards as a reliable index of physical efficiency. It is obtained by the following formula: $F = H - (C + W)$. In this, F represents the factor, H a man's height in centimetres, C his chest measurement at maximum expiration, also in centimetres, while W is his weight in kilogrammes. The larger the excess of H over $(C + W)$, or in other words the larger the factor, the poorer the man's physique. In rare cases $(C + W)$ may be larger than H and then F becomes negative. This occurs only in exceptionally powerful men. As representing ordinary indi-

viduals, we find a man 5 ft. 1 in. in height, with weight of 145 lb. and minimum chest measurement of 36 in. gives a factor of — 3; similarly, a man of 5 ft. 5 in., a weight of 139 lb. and minimum chest girth of 37 in. gives a factor of 6; another man of 5 ft. 3 in., a minimum chest girth of 34 in. and a weight of 122 lb. gives a factor of 18; while a man of 5 ft. 9 in., with chest girth of 32 in., and weight of 119 lb., gives a factor of 40. It is obvious that the short, stout, or sturdy type of man will on this scale give the lowest range of factor, while the tall and lean man will give a correspondingly high factor. We find all types in the material under review.

After determining his formula, Pignet evolved a scale for classifying men according to the size of their factor. This classification is as follows:—

Factor less than 10	Very strong.
„ 10 to 15	Strong.
„ 15 „ 20	Good,
„ 20 „ 25	Medium.
„ 25 „ 30	Weak.
„ 30 „ 35	Very weak.
„ over 35	Useless for the Army.

The formula of Pignet is now in general use among medical officers of European armies, by whom it is regarded as affording a safe guide in judging the physical fitness and effects of training of soldiers. Although all the measurements of the Indian soldiers which are now under review were recorded in inches and pounds, it was thought worth while to convert them to centimetres and kilogrammes, and apply Pignet's formula to the whole of the material. It is curious to see the result. It works out as follows for the whole mass of 5,676 men recorded.

169	had a factor of less than 10	= 2·9 per cent
530	„ „ between 10-15	= 9·3 „
924	„ „ „ 15-20	= 16·2 „
987	„ „ „ 20-25	= 17·3 „
1,455	„ „ „ 25-30	= 25·5 „
946	„ „ „ 30-35	= 16·4 „
665	„ „ over 35	= 11·7 „

Judged, therefore, by Pignet's standard for the French, about 50 per cent of these Indians belong to the weak classes, or 70 per cent fall into the moderate and weak classes. Of course the standard is a severe one to apply to these sepoys, as the Aryan races are physically quite different from the Latin, the Teutonic, and the Celtic races; still, the result is interesting. If, however, instead of regarding the data only in bulk, we arrange the material into the selected racial groups we see not only how they respectively conform to, or depart from, the high standard of Pignet, but

also realize that the test shows these Indian soldiers in a far from unfavourable aspect. The following table gives the respective percentages yielded by each of the thirteen groups.

	Under 10	10-15	15-20	20-25	25-30	30-35	Over 35
Hazaras	7·10	20·23	35·23	20·16	15·83	1·45	*Nil*
Pathans	8·16	9·84	19·73	23·55	28·34	9·88	*Nil*
Sikhs	2·33	6·66	18·22	11·32	22·08	22·25	17·04
Punjabi Hindus and Musalmans ..	1·43	5·90	23·89	12·59	23·49	17·57	15·13
Baluchis	—	19·16	21·34	17·39	19·16	15·73	6·92
Rajputs	1·88	8·68	14·68	16·44	28·17	17·89	11·88
Rajputana Hindus and Musalmans..	—	3·77	4·86	13·48	39·26	30·85	7·42
Hindustani Hindus and Musalmans	0·70	4·92	4·92	18·46	31·77	22·09	17·06
Dekhanis	—	2·62	5·64	15·20	44·11	22·52	9·81
Gurkhas	5·52	19·44	19·24	21·85	19·94	6·98	6·53
Garwhalis	5·54	14·88	31·18	8·67	28·04	4·26	7·13
Dogras	0·90	7·64	12·77	23·51	15·00	25·11	14·05
Madrassis	—	3·18	7·78	22·76	31·34	16·46	18·08

The figures for Garwhalis, Rajputanis, Baluchis and Hazaras, being based upon relatively small numbers, may be somewhat fallacious, but even as they are they may be accepted as fairly representative of the types. Among the Hindustanis, the lower factors were given by the men classed as Brahmans, some of whom appear to be of fine physique.

The foregoing being the facts, it is of interest to see how these figures for men of the Indian Army compare with corresponding analyses for similar men of other armies. Some very interesting data were furnished recently on this point by Major Balck of our Corps,[1] and, from his article, we are in a position to give the facts relating to forty-one raw recruits enlisted in England, for 344 British soldiers serving at home with three months' service, and as to the same men after six months' service, also as to 859 recruits joining at Gumbinnen in East Prussia, 9,779 recruits in Baden, and 8,453 Bavarian recruits. By utilizing the data given by Major Balck and comparing them with our own, we are able to make the following comparative statement.

	– 10	10-20	20-30	30-35	+ 35
British recruits	—	9·7	24·3	22·0	44·0
,, soldiers of 3 months service	1·4	10·3	45·0	23·9	19·4
,, ,, ,, 6 ,, ,,	1·7	15·9	45·9	26·1	10·4
Prussian recruits	5·4	39·3	51·9	3·0	0·23
Baden ,, ...	4·7	28 0	45·6	13·6	8·10
Bavarian ,, ...	7·8	40·5	49·5	1·7	0·20
Indian Soldiers	2·9	25·5	42·8	16·4	11·70

[1] JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, July, 1912, p. 85.

Regarded in this way, we find that the Indian soldier with six months' service compares favourably in the matter of physique with the 344 British soldiers having the same length of service. Allowing for the differences of race, the Indian soldier holds his own with the German. In fact, if we tabulate the facts, as in the following table, we find that the mean of certain races or class groups among the Indians, such as Hazaras, Pathans, Baluchis, Sikhs, Punjabis, Gurkhas and Garwhalis, conforms closely to that of the three groups of Germans.

	– 10	10-20	20-30	30-35	+ 35
Mean of selected Indian races	4·52	37·83	38·91	11·16	7·53
,, German groups ..	5·96	35·93	49·06	6·10	2·87

The selected Indian groups constitute 65 per cent of the whole material under analysis, and that the figures for the whole mass do not show better is due to the fact that large numbers of Indians are spare men and rarely run to flesh. This makes the weight of an Indian to be relatively low in proportion to his height. It follows from this, his Pignet factor is inclined to be high. Though the Indian soldier does not give a very high percentage of men with very low Pignet factors, that is below 10, still he does not give many with very high factors of over 35. He conforms closely to the "Good" and "Moderate" groups.

For Indian statements, a good working scale to adopt for Pignet's factor, if it were ever to be taken up in India, would be to class 10 to 15 as "Very strong," 15 to 20 as "Strong," 20 to 30 as "Good," 30 to 40 "Indifferent" and over 40 as "Weak" or "Undesirable." Those having factors of less than 10 might be either classed as "Exceptionally strong" or simply included with the 10 to 15 group or "Very strong." On this latter basis, the 5,676 cases analyzed give as percentages: 12·2 as "Very strong," 16·2 as "Strong," 42·8 as "Good," 23·9 as "Moderate" or "Indifferent," and 4·2 as "Weak" or "Undesirable."

In submitting this analysis, one is conscious that it presents certain defects. But the mass of material has been very difficult to analyze, and such analysis as one has made has been very irksome at times and somewhat laborious. It is hoped that the trouble taken may be of some interest. If it does nothing else, it will or should show that, in the comparative sense, the material from which the Indian Army is recruited is good, and in the case of some particular races is very good.

TRAVELLING KITCHENS.

By Captain N. DUNBAR WALKER.
Royal Army Medical Corps.

In proportion as the fighting strength of modern armies has been increased, the difficulties of provisioning them have likewise been enhanced, and to supply men in the field with hot, cooked food, especially when moving, is a problem the solution of which has been acknowledged by the military authorities of all countries to be of paramount importance.

The small mess-tin carried on the person is a poor article for preparing a proper meal, yet in practice it has often been the only utensil available since until lately the camp kettles of our British infantry battalions were carried in the second line transport, which often failed to arrive till many hours after they were required. The recent introduction of a "cook's wagon," which contains camp kettles, into the first line transport (pending the issue of travelling kitchens to all units) is an innovation likely to enable the soldier to obtain food properly cooked, either at once on getting into camp or actually on the line of march. Further it has even been suggested that the prospect of a hot meal has a moral effect in keeping a company together and attracting stragglers. The use of travelling kitchens is apparently the ideal method of supplying hot meals to the soldier when on the move and also in camp.

The chief defects of these vehicles are the large road space they require, and their great weight, which renders them unfit to leave the metalled road. The latter disadvantage was experienced by the Russians in the Russo-Japanese War, but in spite of this travelling kitchens were much used, the vehicles being brought right up to the firing line during the prolonged actions. They also would probably increase the difficulties of a retirement. The kitchens should be able to follow infantry along roads at a trot, and also to get over soft and uneven ground. If possible their weight when loaded, but without the driver, should not be much over 20 cwt., and they should be capable of cooking for 250 men. It is essential that their centre of gravity should be as low as can be arranged, without interfering with a clearance underneath sufficient to allow of the wheels at times being in deep ruts. They ought to be capable of being turned on narrow roads, and a reliable brake should be provided.

The two-horsed four-wheeled vehicle is a good type, since in this pattern the limber or fore-carriage can be made easily detachable from the hind-carriage or kitchen proper, and both parts can then be used separately, each drawn by one horse. With this arrangement the limber can take the cooked food in felt-lined partitions to the outposts, or fetch supplies even when the kitchen is in use. Space in the limber must be allowed for groceries and the kits of the driver and cook. It is advantageous to have a smaller boiler in addition to the large boiler, so that water for making tea or coffee can be boiled simultaneously with the cooking of meat. These boilers must be jacketed in some way to prevent the food being burnt during the actual cooking, and the jacketing subsequent to damping down the fires acts as a heat-retaining medium. All parts of the vehicle coming in contact with food should be capable of being readily cleansed.

For military purposes these kitchens should not be conspicuous. Bright shining parts are to be avoided in their construction, and the fires should be invisible, and also should burn any kind of fuel. The products of combustion might with advantage be consumed. The various parts of the kitchen should not make too great a noise when the vehicle is in motion. The boilers should be removable so as to render them available for use in houses or tents, or for carriage by pack transport. In a standing camp they can be used for sterilization of water or for the provision of hot water for washing purposes. Some means, such as a box near the boiler, should be provided for drying wood so that fires can be easily kindled at any time.

There are two main types of travelling kitchens:—

(1) Boilers in which cooking can be carried out while on the march.

(2) Heat-retaining receptacles into which partially cooked food is placed before leaving camp.

(1) There are two different types of boiler; those cooking by water and those cooking by steam, while some use a combination of both methods. Those cooking by steam must use steam under pressure, but those cooking by water only may have a free escape of steam, though this is not always the case in practice. Where steam alone is the cooking medium, only a small quantity of water is required, resulting in a reduction of weight.

The chief disadvantages of these boiler kitchens are that they can only be used for stewing or making soup and that the food is liable to get broken up and be tasteless. They can, however, be used as self-cookers.

(2) Heat-retaining receptacles can take one of two forms, a large cauldron or a series of tins. The former usually has an asbestos lining and the tins of the latter are generally placed in felt-lined compartments in a cart. These types can obviously be used for any kind of cooking.

The use of any kitchen as a self-cooking apparatus has the following advantages:—

(*a*) The preliminary cooking may be done at night or early in the morning before the troops march off.

(*b*) There is economy of fuel, since continuous heating is not required.

(*c*) The products of combustion, which might annoy troops or attract the enemy during the march, are not evolved.

Trials have been made with many varieties of these two types of travelling kitchens, and a short description follows of the most successful vehicles used or in use among some of the European powers.

Great Britain.—It is only within the last two years that official trials with various forms of travelling kitchens have been undertaken. During the training season and manœuvres of 1910, some six different types were officially tested.

Of these six types, the Mills' and Sykes' (Lune Valley Co.) cookers will be described; the other types comprised a limbered cooking wagon, a Swiss cooking cart, a G. S. wagon fitted with oil burners, and an ordinary cooking stove placed in a G. S. wagon.

The authorities have favoured the limbered design, and after further trials during 1911 a considerable number of improved pattern travelling kitchens were issued to the troops during the 1912 manœuvres.

This type is described under No. 16035 list of changes in war material, issued with A. O., August 1, 1912.

Travelling Kitchen, Mark I.—This wagon consists of body and limber and is constructed to cook for 250 men; it carries rations, fuel, spare parts and equipment stores. The body consists of seven open compartments, five for boilers, and two (one on either side of the rear boiler) for fuel, a fire-box and a perch.

The limber consists of four boiler compartments at the front, and compartments at the rear, to contain cook's implements, and rations of jam, sugar, salt and tea. The rear compartments are closed by a lid to which is attached a cutting board. The boilers can be lifted from the body by a jointed-bearer and placed in the compartments of the limber, which are lined with asbestos

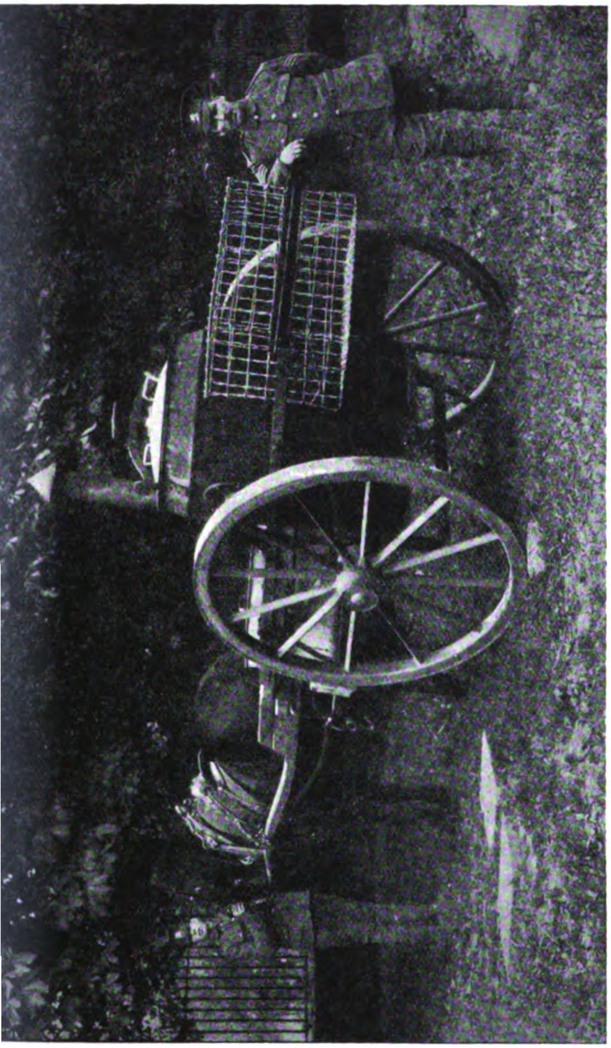

Fig. 1.—Mills' Patent Travelling Portable Cooker.

fibre. Here the food can be kept hot. The body and limber must always be kept in a horizontal position when in use and the limber can be used separately for distributory purposes. The capacity of each boiler is 6·5 gallons and the groceries carried weigh 87 lb.

The length of the vehicle limbered up is 22 ft. 8 in. and it is capable of turning in a circle with a diameter of 27 ft. Weights: Body and limber empty, 17 cwt. 1 qr. 14 lb.; loaded, 24 cwt.

Mills' Patent Portable Travelling Cooker.—This apparatus has been used by many units during training and manœuvres, and has given great satisfaction. These cookers can be made in different sizes to suit either a half battalion of infantry or a squadron of cavalry or battery of artillery, i.e., from 100 to 500 men. It is a two-wheeled vehicle usually drawn by one horse. There is a swingle-tree for a second horse, if required. The cooker for half a battalion (440 men) consists of a boiler mounted on trunnion brackets, supported on powerful spiral springs; the boiler is allowed to swing free, thus remaining level when travelling and also when at rest. There is a strong iron outer casing to the boiler with a 3-inch space between the inner and outer parts. In order to prevent sediment settling or solid matter resting on the bottom of the boiler which might lead to burning, the boiler is provided with a false bottom in the form of a shallow receptacle with a perforated hinged lid. On the top of the false bottom there are four triangular iron baskets to contain the meat; these fill the boiler space. The boiler lid is screwed down by one large clamp, hermetically sealing up the contents; there is a small safety-valve in the lid. In front of the carriage, between the shafts, there are eight mess-tins packed in nests of four, the centre one of each four carrying sufficient potatoes for the meal. There is an iron basket at the back of the boiler for the purpose of carrying the fuel—wood, coal, or coke. The boiler can be removed from its carriage and the carriage used as a cart. By tilting up the shafts the boiler will rest on the ground. The method of using the cooker is as follows: Before moving off, the meat, &c., is placed in the four interior receptacles, the necessary water is run in, and the lid clamped in position. The fire is lighted from two and a half to three hours before the approximate time arranged for the meal. When the safety-valve blows off (6 lb. pressure), which occurs in about one and a quarter hours, the fire is damped down and automatic cooking then proceeds with a very small expenditure of fuel. Half an hour before

the meal is required the potatoes are placed in the boiler in nets and are cooked by the steam. On arrival in camp the four containers are lifted out and the meat, potatoes, &c., are divided between the eight mess-tins. The false bottom is lifted and the sediment is mixed with the stock, the whole being run off into the tins by means of a tap at the base of the boiler. The whole weight of the cooker is 14 cwt., and it can be easily man-handled. When filled with food and fuel the weight is about 25 cwt. Dinners for 450 men can be cooked with 200 lb. of wood, and tea for the same number can be prepared with 100 to 150 lb. of wood.

The Lune Valley Engineering Company Portable Field Cooker (fig. 2).—This kitchen is made by the above firm of Lancaster, and fitted with their patent simplex paraffin burners. The cooker is made in two sizes, a two-wheeled type cooking for 500 men, and a four wheeled type for 1,000 men. The actual cooker can be placed in any transport wagon. Although oil is the fuel recommended, they can be constructed to burn wood, coal, or coke. The large type is rectangular in shape, and is swung in a series of trunnion pivots so arranged that in passing over rough ground the cooking-vessels are always level. There are four boiling pans with a capacity of 1,000 gallons. Below the boiling-pans are situated two burners, which heat by radiant heat, and four grills arranged to pull out like drawers. The range is lined with asbestos, and the burners can be regulated to give as much heat as required. On removing the boilers two frying-pans can be put to work in their places. The oil for the burners is carried in two steel tanks. The total weight without food is about 12 cwt. It is claimed that there is no smell or smoke, that the apparatus will boil, grill, bake, and fry, and that the range can be used in standing camps and barracks as well as on the march. One man only is required to look after it. The smaller type is similar, but with two boilers only. A vegetable steamer in which water can also be boiled for tea and coffee can be added at one end if required.

India.—Heat-retaining boxes have been used by various units in India; for a description of such an apparatus see this Journal, vol. xviii, p. 579 [2].

France.—Travelling kitchens were first tried on medical manœuvres during 1905.

At present there are two types in use: (1) That of Capitaine de la Taille, which is on the Norwegian principle, and (2) the boiler type, with the free escape of steam, of M. Mottant.

(1) In this type there is no actual stove or fire. The food is placed

FIG. 2.—Lune Valley Portable Field Cooker.

ns (two per section, one for the morning and one for the
eal) and brought to the boil, if it is a stew, and the tins
placed in a cart in felt-lined partitions. The cooking
uring the march, and is complete in four hours; even
ty-four hours the temperature is said to be as high as
° F.). Any sort of cooking can be carried out with this
The cart is two-wheeled and drawn by two horses. It
5 kilos. ($10\frac{3}{4}$ cwt.) and provides for one company (250

sine roulante Mottant à échappement libre (*Infantry Type,*
1910).—This is a travelling kitchen on two wheels, drawn
two horses. The box-seat is divided into three compart-

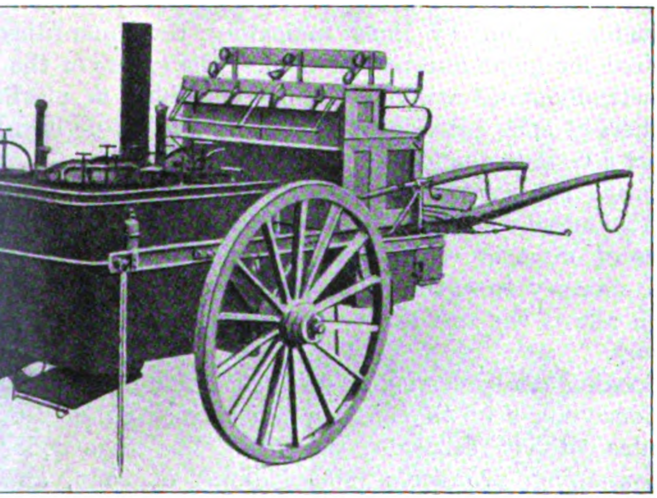

Fig. 3.—Cuisine roulante Mottant (1910 type).

One in front, well ventilated by shutters of perforated
, contains two pairs of boxes for meat. The lower com-
behind contains four boxes for vegetables arranged in the
ner, and a case for two knives and a fork. The upper
ent behind is closed by a movable shutter, which lets
ning a table. To this shutter is attached a coffee-mill,
ous cooking utensils and a box for coffee are kept in the
ent.
ove is fixed in the chassis by four spring attachments. It
ith two boilers made of tinned steel. The larger one on

the right is for cooking soups, stews, &c. The one on the left is for boiling water to make coffee and tea, and if necessary, for sterilization of water generally. Each boiler has its own grate closed by sliding doors which can be opened at will to increase the draught. Any fuel can be used, but wood is preferable. The products of combustion are carried off by a chimney provided with flues for cleaning purposes. The walls of the stove are covered with a layer of asbestos, which prevents heat being lost, and enables the apparatus to be used as an automatic cooker. The capacity of the large boiler is 450 litres (99 gallons), and the smaller 65 litres (14·2 gallons). Each boiler has a tap to which is attached a hook from which utensils to serve the soup can be suspended; means are provided for locking the taps. The boilers have neither lead covering nor any copper parts, and all kinds of cooking are possible. They are graduated within by lines indicating the quantities of water required for given numbers of men. The covers of the boilers are hermetically closed without the use of rubber or plastic material. Washers of such materials are liable to be lost or burnt, and may impart a taste to the food.

Inside the soup boiler, and just opposite the tap, there is a movable metal piece kept in position by a vertical guide, to prevent pieces of meat or vegetables from entering the tap. There is a little chimney to each boiler, capped by a small perforated top, which allows the free escape of steam (*à échappement libre de la vapeur*).

Cooking can be carried on during the march, and if the fires are previously made up the kitchen can travel at the trot for twenty minutes without recharging the fires. The large boiler is capable of containing 275 litres (60·5 gallons) of soup, and 130 kilos (2·5 cwt.) of meat at one time.

When the meat is cooked it is advisable to take it out of the boiler and place it in the boxes provided in the box-seat. When it is required for issue it is first replaced in the soup just before serving and warmed up. If the meat is left in the boilers it is very liable to become overcooked and fall to pieces. There is a cavalry model, with a limber, which is similar in all respects. The weight of this kitchen, complete with accessories, is 650 kilos (12·75 cwt.), and it will cook for a company (250 men).

Germany.—Moltke, as long ago as 1860, advocated the use of travelling kitchens [4], but it was not until lately that, as a result of two public competitions during 1905-06, an official type of travelling kitchen was adopted, and in 1908 the sum of 1,000,000

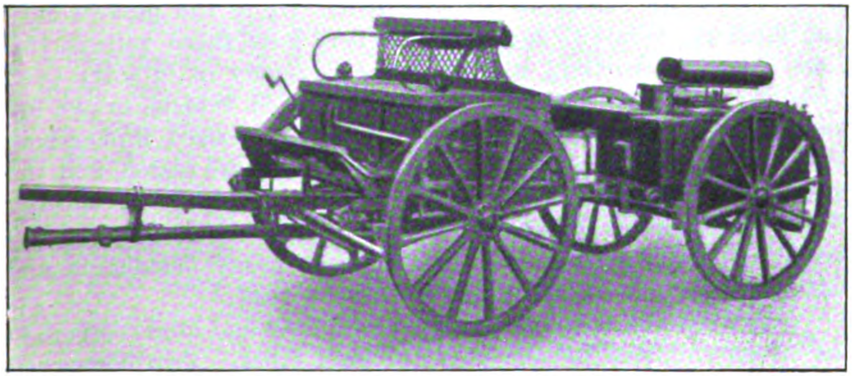

FIG. 4.—German Travelling Kitchen.

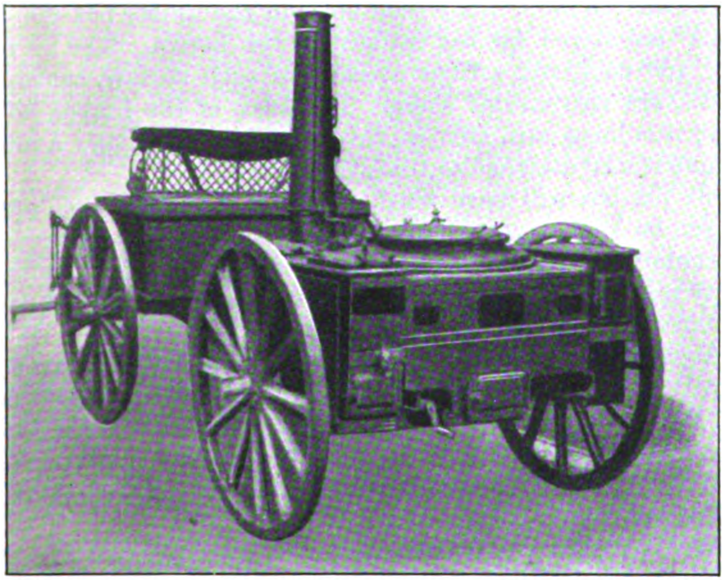

FIG. 5.—German Travelling Kitchen.

(Figures 4 and 5 are reproduced by the kind permission of the Comptroller of H.M. Stationery Office.)

marks (£50,000) was voted in the army estimates for the purpose of providing field kitchens for the army. Up to the present only the infantry, pioneers, and heavy artillery have these vehicles [5]. The German travelling kitchen for a company of infantry (war strength, 250 men) consists of a four-wheeled vehicle, drawn by two horses. The fore-carriage is a fairly large-sized limber box, without springs, on which the driver and cook are seated, and the hind-carriage carries the cooking contrivance slung on springs. Both carriages are joined to each other by a well-designed spring coupling which renders the hind-carriage easily detachable and enables the whole to turn even on a narrow road.

Extra shafts are carried enabling both fore- and hind-carriage to be driven singly or independently of each other. Two horses can be attached to each if required. It is claimed that the vehicle may be driven across hills and ditches at right angles or obliquely, both fore and hind carriages adapting themselves to the nature of the country, but in actual practice they have been found too heavy to move off the road. In pigeon-holes in the limber box 200 "iron rations" are stored, besides rations for the horses. The kit of the driver and cook and various accessories such as saw, canvas pail, axe, &c., are also carried there. The back of the limber box lets down; it is lined with zinc, on this meat can be cut up; a mincing machine is also attached to this shelf.

The fire-box will burn wood, coal, peat, or patent fuel, and the fires can be kept alight while on the move. With a moderate fire the contents begin to boil in about an hour; after boiling for twenty minutes the ashpit and damper are closed and the cooking continues automatically.

Provided the boiler is not opened, it is stated that even after twelve hours the temperature will not have fallen below 60° C. (140° F.). It is necessary to re-heat every twelve hours if the food is not required by that time, in order to maintain a temperature of 50° C. (122° F.). If the temperature is allowed to drop below this, the food is liable to become sour.

Food is reported to be palatable even after a period of seventy-two hours, provided it has been re-heated several times. Water in the rectangular boiler will commence to boil with a moderate fire in about three-quarters of an hour.

About 175 litres (38½ gallons) of stew can be prepared in the large boiler at one cooking, and the food is served out in a ladle holding ½ litre (17½ fl. oz.). The regulations urge the use of these kitchens as self-cookers whenever possible; the advantages of this method of cooking have been enumerated elsewhere.

These vehicles are called by the men "Erbsenkanone" (pea-guns), and each battalion (war strength 1,056 men) has four in the "Gefechtsbagage" (first line transport) [6]. There is a cook to each, and the four cooks are supervised by a N.C.O., under the orders of the supply officer. Heavy artillery and pioneers have these kitchens, but not cavalry and field artillery [7].

The cooking contrivance fitted to the hind-carriage of the vehicle consists of a copper or boiler capable of holding 200 litres (44 gallons) used for stews and soups, and a rectangular boiler holding 70 litres (15½ gallons), intended for coffee making. The larger circular boiler is central; on its left is the smaller boiler, and on its right is a box containing all the requisites for making coffee. In the rear of the large boiler there are separate spaces for drying wood, storing the fluid for the bath, and for placing firing and cooking implements. Each boiler has a separate fire-box, with its own flue leading into a common collapsible chimney. The large boiler has double sides, the inner of pure nickel, the outer of copper, the intervening space of 7-10 mm., known as the "cooking bath," is filled with glycerine (boiling point 290° C.). The glycerine will last five months and does not freeze. It is closed by a lid screwed down by wing-nuts and perforated by a safety valve.

The smaller boiler is made of pure nickel and a strainer of the same metal is provided. Wood, 38 kilos. (84 lb.), for one day, or coal, 45 kilos (100 lb.), for three days can be carried. This fuel allowance is sufficient to cook two meals per day. For a meal including the preparation of coffee, 16 kilos (35 lb.) of wood, or 13 kilos (28½ lb.) of coal are required. Fifteen kilos (33 lb.) of wood is the regulation allowance per company at war strength. The total weight of the whole vehicle loaded is about 1,310 kilos (25¾ cwt.). The weight of the kitchen empty is 850 kilos (16½ cwt.).

Russia.—Although possibly the idea of travelling kitchens was conceived by Moltke, the Russians [8] were the first actually to take the matter up practically, making experiments as far back as 1860. It is probable that on account of the long distances their troops were required to travel when moving station or going to manœuvres, the subject of supplying the troops with cooked food presented itself very forcibly. Automatic cookers were first tried by the troops in Finland and Turkestan, but were not considered satisfactory, though excellent results were reported from Turkestan, even in very great cold. By the end of 1880, on the initiative of General Gourko, Military Governor of the Warsaw district, nearly

all his troops had been provided with kitchens consisting of boiler and fire-box on wheels. In 1897, the authorities instituted a competition, fourteen models were entered, with which experiments were made in camp and on manœuvres during 1898. Two models were chosen as the best, those of M. Zaleuski (Brun-Zaleuski) and Colonel Bogaïevski [9].

Colonel Bogaïevski's type (a two-wheeled model) cooked by means of steam under pressure; that of M. Zaleuski was of the ordinary four-wheeled boiler type. Further satisfactory experi-

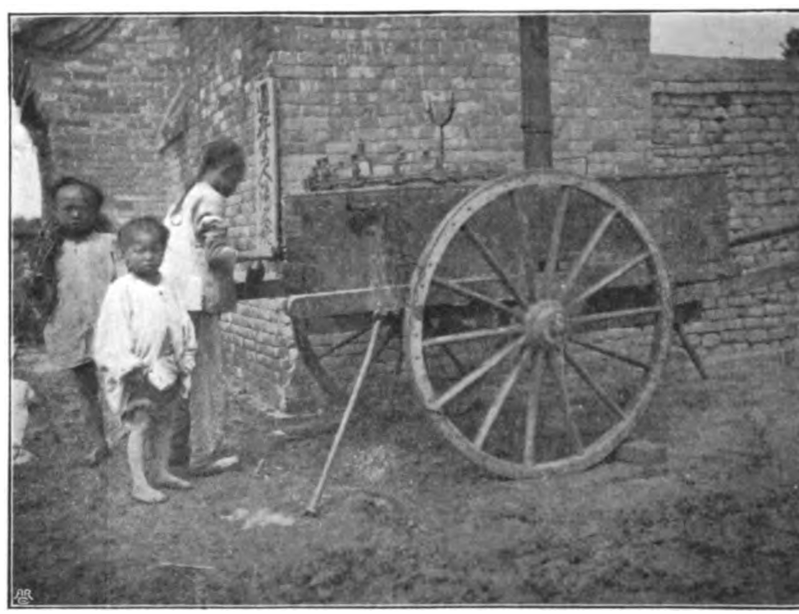

Fig. 6.—Russian Travelling Kitchen in Manchuria. (Reproduced by kind permission of the Comptroller, H.M. Stationery Office.)

ments during 1899-1900 with these two types led the authorities to authorize their official introduction, and in 1902 6,000,000 roubles (£625,000) was voted to supply the whole army with kitchens. It is interesting to note that the Russians spent no less than forty years in experimenting before officially adopting travelling kitchens. Although practical experience in China proved the superiority of M. Zaleuski's model some regiments preferred Colonel Bogaïevski's, because it was lighter and could, in an emergency, be drawn by one horse.

In Manchuria, two sizes of each of these types were in use, but there were only very few of the steam cookers. The Brun-Zaleuski model was either on four wheels for a company of infantry (war strength 244 men) or on two wheels for a squadron of cavalry (war strength 155 men). The artillery used the same pattern as the infantry. The infantry pattern consisted of a fore-carriage with two limber boxes divided into six compartments, in which are carried one day's rations for the men, three days' oats, and two days' hay for the horses, and a supply of fuel for one cooking is carried in a cage at the rear of the boxes; cooking utensils are strapped on the outside and one of the compartments is zinc-lined to keep a meal hot. The boiler with a capacity of 307 litres (67½ gallons) is made of tinned copper, with an outer wall of iron. Some insulating material, such as asbestos or oil, is placed between the double walls. A perforated aluminium bottom can be placed in the lid of the boiler for cooking groats. The boiler is closed by a hinged iron lid which screws down. There is a safety-valve in the lid. The whole weighs, empty, 509 kilos (10 cwt.), and loaded up, about 1,150 kilos (22½ cwt.). About 2½ hours are required to cook a meal, with an expenditure of 27 kilos (60 lb.) of wood.

The cavalry pattern differs in the following points: there are only four compartments in the limber box, one, the largest, for wood, one for the cooking utensils, one for rations, and one zinc-lined for keeping food hot. The capacity of the boiler is 172 litres (38 gallons). The weight, empty, is 305 kilos (6 cwt.), and loaded, 815 kilos (16 cwt.). Both patterns are two-horsed, the horses drawing the cavalry pattern being yoked tandem [10]. These types only stew and make soup, but there was an officers' pattern which could roast. An infantry regiment (4,041 men) had 17 cookers, and a cavalry regiment had six (four-squadron regiment, 779 men). The boilers can be removed from the carriage and carried on pack transport. When troops are moving, the meat is cooked for 2½ hours and then placed in the zinc-lined partition where it can be kept warm.

Captain Marinitsch's Kitchen.—This is a portable or camp kitchen [12] that can be carried either on wheels or as a pack load, comprising one or more boilers with one furnace. The ordinary type for the soldier consists of one boiler, which will hold 148 quarts and will cook for a squadron (155 men). There is also a larger type holding 270 quarts, and a four-boiler type for officers with a capacity of 80 quarts. For pack transport the load is divided among three horses. The wheels, axle, harness and

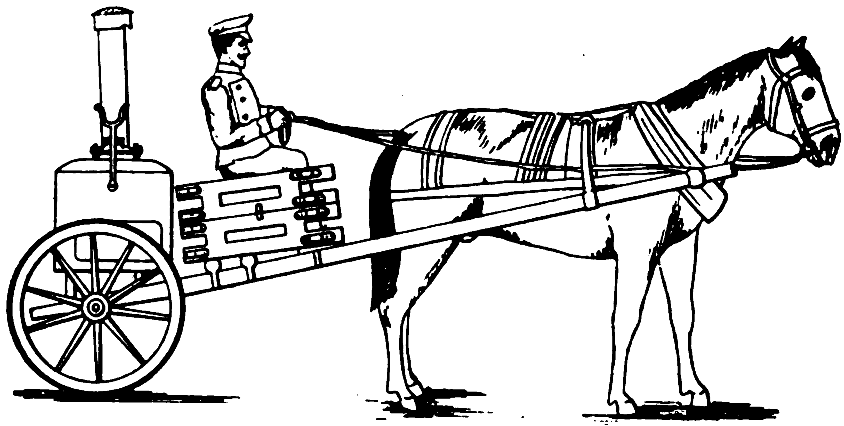

FIG. 7.—Capt. Marinitsch's Kitchen (Wheeled Transport). (Copied from the British Patent Specification.)

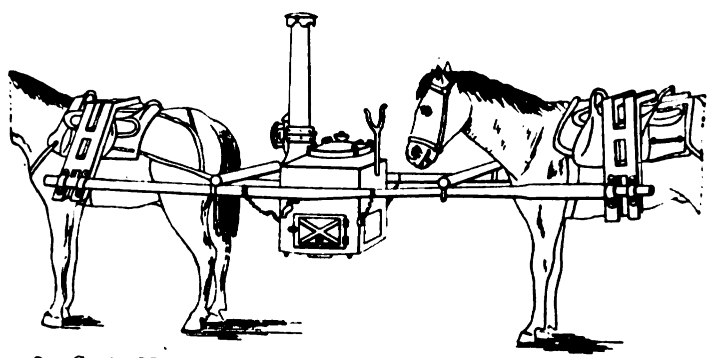

FIG. 8.—Capt. Marinitsch's Kitchen (Pack Transport). (Copied from British Patent Specification.)

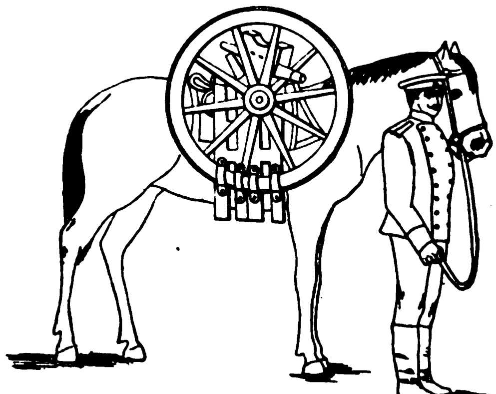

FIG. 9.—Capt. Marinitsch's Kitchen. (Pack Transport.) (Copied from British Patent Specification).

sundries are carried on one horse. The boiler is suspended by chains from the middle of the shafts, the ends of which are carried by trestles secured across the saddles of a pair of horses, one behind the other. Cooking can proceed when the boiler is in this position. The weight carried by each horse with the smaller type is 175 lb., and with the larger type 240 lb. If the kitchen is empty the whole can be carried on two horses, the wheels, &c., being attached to the shafts. Two men are sufficient for its management, one to lead the single-horse and the other to lead the leading horse of the pair.

To convert it from pack transport to wheeled transport takes under ten minutes. It is then drawn by one horse driven by one of the men, and the other man rides the second and leads the third horse carrying some spares. The kitchen on wheels can be moved at a trot, and it will keep up with cavalry. The size of the kitchen enables it to be removed from the carriage and conveyed into houses or tents. The cart itself can then be used for any kind of transport. The inventor claims the following advantages: Although it is primarily for mounted units it can be used by all arms; it takes up very little space in bivouac; it is easily repaired; it may be heated with any kind of fuel; no special pack-saddles are required; it is a much cheaper and lighter system than any other.

Austria.—Parkes (1878) mentions that a Viennese engineer altered a Papin digester in such a way as to make a convenient cooking utensil, which was then used by the Austrian medical units.

Experiments were made during the manœuvres of 1907, the Minister of War having invited those firms interested in such vehicles to send models for trial. The conditions were that a kitchen should be capable of preparing at one time either 250 rations (infantry type) or 160 rations (cavalry type). Their weight unloaded was not to exceed 500 kilos (9¾ cwt.), or loaded, 900 kilos (17½ cwt.). Several different vehicles were tested, two cooking by steam, the others by direct boiling. They included three Russian patterns, five from the firm of Weiss, Budapest, and the remainder from other Austrian firms. Automatic cookers were also tried, these consisted of two cooking-tins (one per section of twenty-five men) in a box.

The reports favoured the boiler types, although none of them came within the maximum weight laid down. All the types were drawn by two horses, and, as a rule, had three large boilers for the men and two smaller ones for officers, besides an oven and the

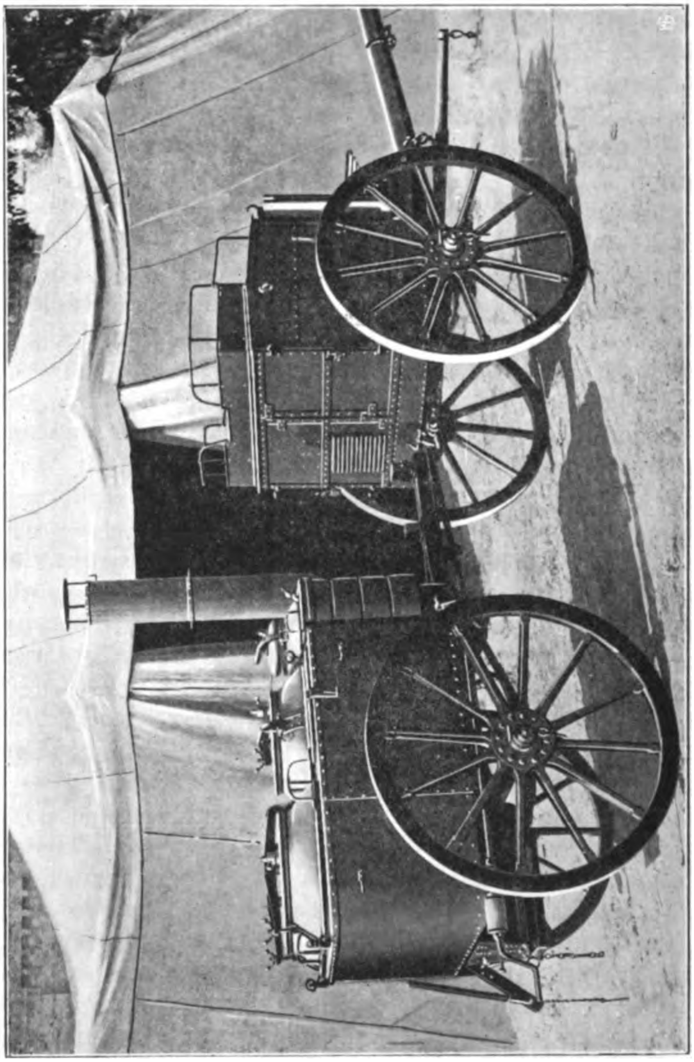

FIG. 10.—Austrian Army Travelling Kitchen.

usual cooking accessories. A conference after these manœuvres favoured the abolition of the officers' boilers in order to reduce the weight, and recommended that the kitchens should take the place of the ammunition wagons during an ordinary march, but should be placed in the rear with the heavy baggage during marches in the presence of the enemy. It was agreed that nickel was the most suitable metal for the boilers. In 1908, travelling kitchens were officially adopted, and by 1909 practically all units had them, but as they officially marched with the heavy baggage they were not always at hand. Now these vehicles are first line transport. In 1908, trials were made with motor kitchens [26].

The 1909 infantry pattern of travelling kitchen consists of a fore and hind carriage drawn by two horses, the fore-carriage being divided into ventilated compartments for food, stores, cooking utensils, &c. There are three boilers of 92 litres (20·3 gallons) capacity each, one for boiling water and two for cooking different dishes. Each boiler is made of pressed sheet nickel, fitted with an air-tight cover, a hinged closing lever and a safety-valve. All three boilers can be used simultaneously on the carriage and are removable.

The fuel employed may be wood or coal. The weight of the complete equipment is 575 kilos (11·3 cwt.), the limber weighing 205 kilos (4 cwt.) and the kitchen 370 kilos (7·2 cwt.). The kitchen can cook at one time dinners for 250 men, with an expenditure of from 10 to 15 kilos (22 to 32 lb.) of wood. The manufacturers are Manfred Weiss, of Budapest [12].

Cooking-chests are issued to small units and to mountain units (13). The Weiss cooking-box (1910 pattern) contains a nickel boiler with a capacity of 26 litres ($5\frac{3}{4}$ gallons), which can be hermetically closed, and is provided with a safety-valve. On taking it out of the box, the boiler automatically stands on a suitable frame of sheet steel, which serves as a fireplace. After heating for twenty-five minutes with the valve open to bring the contents to the boil, the boiler is replaced in the box with the safety-valve shut. The box, which is lined with some non-conductor, is then closed and placed between the lid and the boiler, and the whole placed on a mule or cart. It is claimed that after two or three hours the contents of the boiler are cooked and that even after twenty hours the food is still at a temperature of 60° C. (140 F.). The weight of the box complete is 21 kilos (46·3 lb.) and the boiler is large enough to supply meals for 25 men at a time. This type of cooking-box is also in use in the Italian and Roumanian armies.

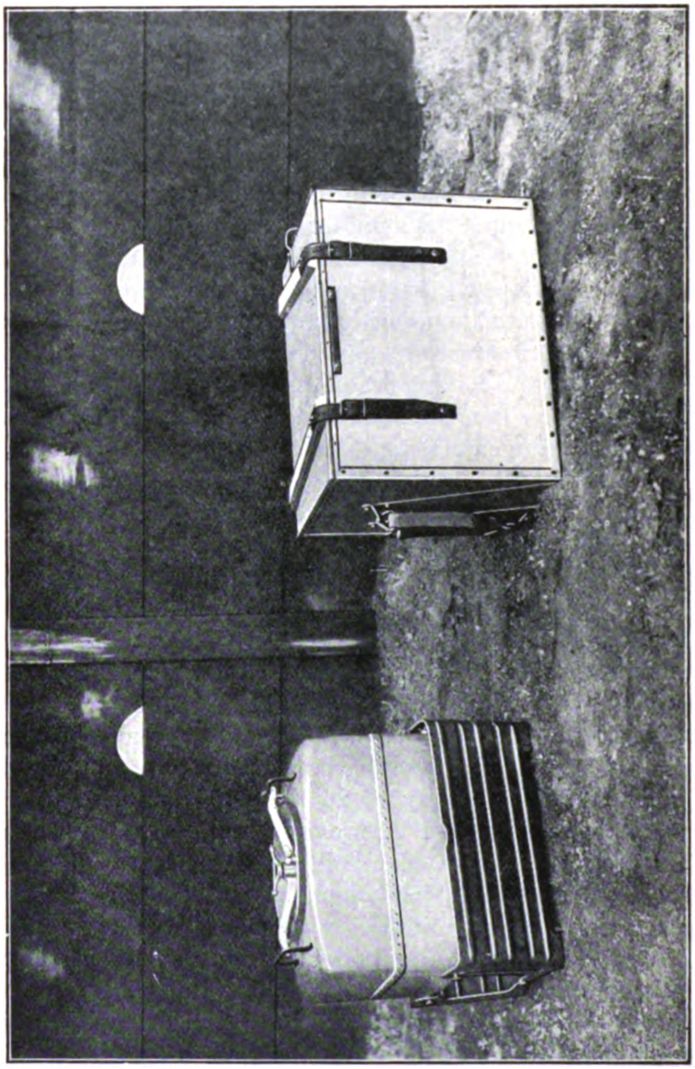

Fig. 11.—**Austrian Army Cooking Chest.**

Italy.—During the Alpine manœuvres of 1906, an automatic cooker (Achillini) was tried, consisting of a box lined with tow, within which the half-cooked food (boiled for twenty minutes) was placed in the cooking-tins. In about three to four hours the food was completely cooked. Latterly, a cylindrical cauldron or boiler has been tried, it cooks for 50 men; the boiler stands on three legs, and has a lid fastening down with wing nuts. The cauldron has double walls with an asbestos filling. The contents are heated to the required temperature, which takes from ten to fifteen minutes, the lid is then secured in position and the boiler placed on a cart where the cooking continues. The type (Neumann) that has finally been approved consists of a nickel boiler fitting into an iron stove. There is an outer wooden cover lined with some non-conducting material. It cooks for 25 men, and 10 of these cooking-pots are carried in a two-horsed vehicle and suffice for two companies (peace strength, 110). About an hour's cooking is required before placing them in the carts, where the cooking continues and food is stated to keep hot for twenty-four hours [14].

Switzerland.—In this country all units have kitchens. The first introduced was a cavalry model on four wheels which acted as a combined forge and cooker. The fore-carriage contained material for shoeing, saddlery, spares, with an anvil behind. The rear carriage carried a chest for rations, on the sides of which were fixed cisterns of tin plates for milk; below the chest was a box for explosives. Behind these were two boilers heated generally by wood. Water at 7° C. (44·6° F.) placed in them boiled in about forty minutes. Their combined capacity was from 130 to 140 rations. The present infantry type is on four wheels drawn by two horses and consists of a fore-carriage with driving-box containing provisions, behind which is a receptacle for carrying cooking utensils and wood. The hind-carriage has two boilers, their total capacity being 220 litres (48 gallons), which provide for a company (209 men). The fore-carriage weighs unloaded 390 kilos ($7\frac{1}{2}$ cwt.) and the hind-carriage 420 kilos ($8\frac{1}{4}$ cwt.). The total weight of the vehicle loaded with wood, water, salt, coffee, chocolate, sugar, oats, &c., and the driver, is about 1,200 kilos ($23\frac{1}{2}$ cwt.). There are four to each battalion (902 men) [15, 16]. Immenhausen (quoted by Thys) [18] says that for a Swiss division of 13 battalions of infantry and one battalion of Engineers, 51 travelling kitchens are required, occupying a road space of 648 metres (1·2 miles). This gives some idea of how much a column is lengthened.

In January of this year (1912), the Federal Council decreed [17]

the adoption of an automatic cooker (auto-cusine) for mountain troops, machine-gun detachments, pioneers and the medical service. This apparatus consists of a boiler made in nickel with a capacity of 20 litres (17½ quarts) and is similar to that recently adopted for mountain units in Austria. The food is as usual heated up before leaving camp and the boiler placed on pack transport where the cooking continues during transit. In exceptional cases these boilers can be carried by a man on his back.

U.S.A.—In 1906, experiments were made with a "fireless cooker," consisting of a box with an insulating lining in which a tin holding food for twenty-five men was placed; its total weight filled was 145 lb. Later the Subsistence Department have been testing a similar contrivance with two cooking-tins in a box. Each tin has a capacity of 9 gallons, and contains a roaster, which can be removed when a stew is required. Two of these chests cook for a company (war strength 128 men). The weight empty is 400 lb. and full 625 lb. [19].

Norway.—In Norway an automatic cooker is in use consisting of a chest lined with hay or cork, within which the partially cooked food is placed in tins. The chest is closed and cooking continues. The chests are placed on carts or sledges.

Cookers with three boilers, made in Austria, have also been tried.

Sweden.—The infantry are not provided with travelling kitchens, but all mounted troops have some form of cooker.

Holland.—During the manœuvres of 1911, a motor travelling kitchen was tried. The following particulars of this vehicle have been taken from an Amsterdam magazine.

The "Spyker" travelling cooker consists of a chassis (kitchen proper), and a trailer. The chassis is a 15/20 h.p. Spyker, with an extra strong back axle, specially geared down. The speed of this vehicle is about 25 miles per hour. The kitchen can prepare food for two companies of soldiers, or one regiment of cavalry, viz., 530 men. The stove contains four square boilers partly visible behind the chimney. There are two ovens (seen at the side) and two water-kettles each capable of holding about 50 gallons of water for cleansing the kitchen utensils. The four boilers, each containing about 35 gallons, are used for making coffee, tea, or soup. The ovens are used exclusively for meat. The necessary taps are fitted to facilitate the distribution of the food. The stove is made so that it is not necessary to use the four boilers at one time if not required. The heat circulation can be

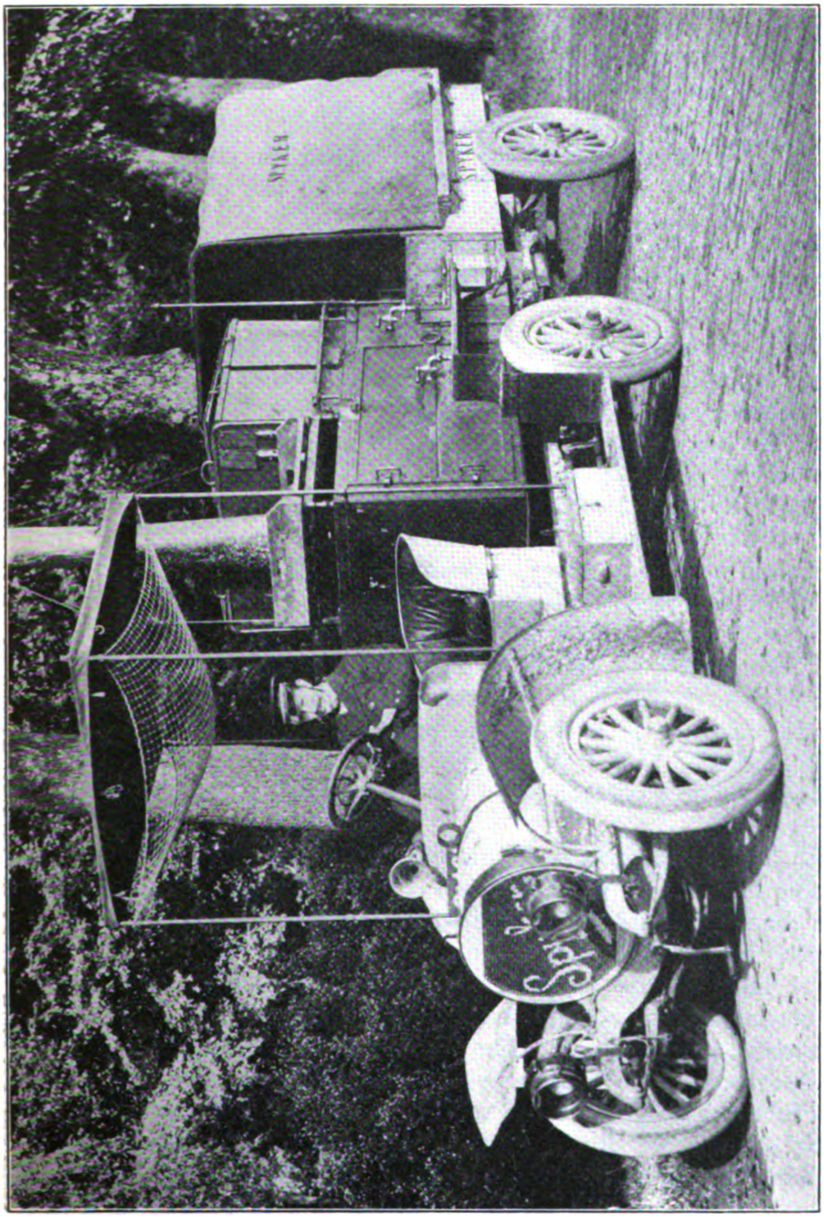

FIG. 12.—Dutch Motor Travelling Kitchen.

regulated so that the two ovens can be equally heated, but the heat can be shut off from them when required. The prepared food can be kept hot for about twelve hours, at the end of which time it will be found to be excellent.

The above-described car proved of great use during the last great dock strike in Amsterdam, for providing food for the cavalry posted in different parts of the town. After the strike it was sent to the autumn manœuvres (1910) for the use of the infantry, cavalry and artillery [20].

The chief advantages of travelling kitchens are :—

(1) They should increase the marching powers of troops in three ways :—

(*a*) By insuring wholesome food at regular intervals.

(*b*) By relieving the individual from the loss of time and fatigue occasioned by preparing his own food.

(*c*) By lightening his load, since the unexpended portion of his meat ration will be in the cooker.

(2) They should lead to a great saving in food materials and fuel, as the inevitable loss occurring when either food or fuel is divided up among several messes is avoided.

(3) From a tactical point of view they have several advantages. Since food can be cooked on the march, the men can obtain their food immediately on halting, which allows the length of a halt to be curtailed should it be necessary. Further, as the kindling of fires in the open is avoided, the presence of troops may be more easily concealed, and, lastly, troops who have to go on outpost duty immediately on reaching camp will be enabled to take with them hot food.

(4) The maintenance of discipline should be assisted as the cooking for and feeding of the men is facilitated, and, as has already been mentioned, straggling should be reduced, as it is a fact that an army marches on its stomach.

(5) They should exercise a wholesome influence on *moral*. Regular appetizing meals mean a healthy body, and in consequence a normal nervous system. The additional comfort afforded to men who may be in the trenches by having a hot meal brought to them is an instance of a help these vehicles may supply in this direction.

No one can be blind to the fact that there are disadvantages attaching to the use of these vehicles. All forms of vehicle are liable to a breakdown, but it would be rare to find an infantry battalion deprived of all its cookers at once. Men might be deprived of their meat, but would still have the unexpended portion of their

bread or biscuit ration, besides their emergency food. The criticism that the men will lose the ability to cook their own food individually has been directed against travelling kitchens, but as training in this art is not to be relaxed, and there will be many occasions when cookers will not be able to follow units (especially when troops are in contact with an enemy) the necessity of using their mess-tins will probably be more frequent than might be thought. The initial cost of providing travelling kitchens for an army is very considerable. The increase in the number of vehicles with an army, and the consequent lengthening of a column, is the most serious disadvantage of all, but it is slightly tempered by the introduction of mechanical transport, which "occupies something like one-fifth of the space of horse transport, and with lorries capable of averaging twelve miles an hour, roads can be quickly cleared" [21].

Reference must be made to other cooking contrivances and utensils used in the field apart from the individual mess-tin and travelling kitchens, but with the introduction of the latter the necessity for these no longer remains.

Great Britain.—Soyer's stoves were first used in the Crimea, and until they and similar stoves were brought out the troops were very badly supplied with cooking appliances. The large Flanders kettles were only used by the artillery, who carried them on the gun-carriage.

Large utensils were also improvised from powder cases, which would cook for forty men, and the Naval Brigade extemporized boilers out of iron, tar, or paint barrels by cutting them in half [22].

The "cook's wagon" of an infantry battalion now carries kettles, camp, oval, 12 quarts, 10 for officers and 63 for the rank and file. Formerly only 52 for the rank and file, and 10 for officers were carried. Particulars of these field service kettles are as follows:—

Name	Weight	Contents	Surface diameter	Depth outside measure	Number of Men will Cook for	
					With vegetables	Without
	lbs.	gals.	in. in.	in.		
Oval, large ..	8	3	$13\frac{1}{2} \times 9$	11	8	15
,, small ..	$4\frac{3}{4}$	$1\frac{3}{4}$	$12\frac{1}{2} \times 8\frac{1}{2}$	8	5	8

A set of butchers' implements is also carried in this wagon.

In India, in the old days, tinned copper boilers and frying pans were in use. The usual oval kettle is now used, and a company of British infantry with the Tibet Mission Force (1903-04) required one mule to carry its complement of these articles.

Germany.—In the South-west African campaign, two camp kettles (diameter and depth 19·7 in.) per company were carried in the transport. The local cast-iron three-legged pots with lids were also employed, but found unsatisfactory on account of their fragility [23].

The cavalry, field artillery, and train formations, which are not equipped with travelling kitchens, carry cooking equipment in their second line transport (*grosse Bagage*).

Austria.—Butchers' implements and materials for making coffee are carried in the company baggage wagons, and a cooking outfit for twelve officers on the staff wagon.

U.S.A.—Many forms of portable cooking stoves, ranges and ovens have been in use from time to time for field cooking. The "Buzzacott" cooking outfit was a pattern officially adopted. It consisted of a steel frame which served as a skeleton stove. In this were packed two sheet iron boxes which joined together to form an oven. Within this oven, on the nesting principle, were packed boilers, pans, and other cooking utensils. Such a field cooking apparatus would cook for 100 men, and weighed from 175 to 200 lb. and measured 25 in. by 35 in. by 14 in. Lately (1910) a slightly larger ($35\frac{1}{2}$ in. by $25\frac{1}{4}$ in. by 17 in.) and heavier (230 lb.) field cooking range [24] for 111 men has been introduced. There is also a small pattern, cooking only for 55 men, weighing 160 lb. and measuring $20\frac{1}{2}$ in. by $21\frac{3}{4}$ in. by $16\frac{3}{4}$ in.

Japan.—One cart carries the following cooking utensils for a company of 240 men: two stoves, three boilers or kettles, three colanders, wooden spoons, buckets, &c. The stove is a cylinder of sheet iron 22 in. in diameter, in six segments, with no top or bottom. It stands $21\frac{1}{2}$ in. high, and each stove is supposed to cook for 120 men. The cast-iron kettle, in shape a truncated cone (diameter at top 2 ft. $5\frac{1}{2}$ in., at bottom 18 in. and $11\frac{1}{2}$ in. deep) fits on to the top of the stove and is covered with a wooden lid.

This kettle has a capacity of 53 litres ($46\frac{1}{2}$ gallons). The colander, which fits within the kettle, is 9 in. deep, and the diameter of the top is 21 in., and that of the perforated bottom $16\frac{1}{2}$ in. Each colander can only cook the rice of from 40 to 50 men at a time, so that three boilings are necessary on each stove to prepare the food of the company. Each boiling takes from forty to forty-

five minutes. The complete company cooking outfit weighs about 387 lb., and can be carried in netting on two pack horses.

In Manchuria, the Chinese camp copper kettles [25], made on the principle of a Russian samovar, were used for boiling water to make tea.

The following are some reprints in the library of the Royal Army Medical College, which give further details of travelling kitchens:—

TRAVELLING KITCHENS.

VINCENZOTTI. "Le cucine rotabilli per l'escerito in campagna," *Revista di Artigliera e Genio*, Rome, vol. iii, July and August, 1911.

KRAUSS. "Feldküchenwagen," *Mitteilungen über Gegenstände des Artillerie- und Geniewesens*, Vienna, No. 1, 1907.

SCHLEYER. "Die Fahrküche der österr.-ung. Armee, *Mitteilungen aus dem Intendanzwesen*, Vienna, No. 6, 1912.

PÖSCHEK. "Zur Frage der Marschküchen," *Streffleurs militärische Zeitschrift*, Vienna, vol. i, No. 2, 1908.

DIAS. "Cozinhas de Campanha Manfred Weiss," *Revista Militar*, Lisbon, vol. lxi, No. 10, October, 1909.

A travelling bakery is being used in the Austrian army, and similar vehicles were used in Tripoli by the Italians. Information regarding these is contained in:—

TRAVELLING BAKERY.

"Le Four Manfred-Weiss" (de l'Armée Italienne), *Revue du Service de l'Intendance Militaire*, Paris, No. 213, March, 1912.

ZARETZKY. "Der Divisionsbäckereibetrieb," Vienna, 1911.

DIAS. "O Fordo rodado Manfred Weiss," *Revista Militar*, Lisbon, vol. lxi, No. 11, November, 1909.

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[4] KRAUSS. "Bekleidung und Ausrüstung der Infanterie," *Streffleurs militärische Zeitschrift*, Vienna, vol. i, No. 3, 1907.

[5] "Felddienst Ordnung," para. 438.

[6] FRANÇOIS. "Der Verpflegungsoffizier," Berlin, 1909.

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[8] PAINVIN. *Revue d'Infanterie*, vol. xlii, July, 1907.

[9] COLONEL "B." "Allègement du Fantassin, Paris, 1905.

[10] NIMIER. "Les Cuisines roulantes dans l'Armée russe," *Revue de l'Intendance*, vol. xix, 1906.

[11] Official Reports, Russo-Japanese War.

[12] *Army Service Corps Quarterly*, January, 1912.

[13] v. Hoen and Szarewski. "Die Armee in Felde," Vienna, 1910.

[14] *Revue Militaire des Armées Étrangères*, March, 1908.

[15] *Revue Militaire*, January, 1912.

[16] Immenhauser. "Cuisines roulantes," *Revue Militaire Suisse*, September, 1909.

[17] *Revue Militaire des Armées Étrangères*, April, 1912.

[18] Thys. "Les Cuisines de Campagne," Brussels.

[19] Havard. *Military Hygiene*, 1909.

[20] "Eigen Haard," Amsterdam, No. 44, November 4, 1911.

[21] Edye. *The Army Review*, vol. iii, No. 1, July, 1912.

[22] Sanitary Commission's Report to Lord Panmure, 1865.

[23] "Sanitäts-Bericht über die Kaiserliche Schutztruppen für Südwest-Afrika," vol. i, part 8, Berlin, 1909.

[24] Munson. *Military Hygiene*, 1901.

[25] Official Reports of the Russo-Japanese War.

[26] "The Armed Forces of Austria-Hungary," *Army Review*, vol. ii, No. 2, April, 1912.

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ON THE RESULTS OF CULTURES MADE WITH MATERIAL OBTAINED FROM THE JOINTS IN TWENTY-EIGHT CASES OF RHEUMATIC FEVER.[1]

By Major W. S. HARRISON.
Royal Army Medical Corps.

In a previous communication[2] I produced arguments in favour of the view that, apart from well-recognized diseases, like gout, gonorrhœa and septicæmias, the symptom group commonly named "rheumatic fever" may be due to a variety of different causes. In the same paper I reported the complete failure of my attempts to isolate the *Streptococcus rheumaticus* of Poynton and Paine from the joint fluid of patients suffering from "rheumatic fever." In the course of these attempts I came across other organisms which I have thought it might be of interest to put on record. The material was usually taken from the knee-joint as soon as possible after its appearance and, as a rule, it was mixed with sterile citrate of soda solution (1 per cent) in order to delay clotting during the subsequent investigation; at the same time smears were made and stained by Leishman's stain, by Gram's method, by iron hæmatoxylin and in other ways, while many specimens were examined under dark ground illumination; this last, however, without any result. Aerobic and anaerobic cultures were made on many different media, varying these as I found that one or other medium failed to give results; in all cases among the media tried were peptone broth, milk broth, and blood agar, in order to ensure that quite simple organisms such as the *S. rheumaticus* were not overlooked.

The cases in which positive results were obtained were as follows:—

(1) A small Gram-negative diplococcus was seen inside one or two of the leucocytes of an exudate; from its position and staining properties one might have thought that it was a gonococcus, but it was much smaller than a gonococcus, about half the usual size, and quite round. In growth on blood agar it gave very fine colonies resembling those of a streptococcus; the cocci on this medium were very small and round, and they showed no tendency

[1] Received for publication January 3, 1918.
[2] Journal of the Royal Army Medical Corps, vol xx, p. 1.

to the production of involution forms; when cultures were made in peptone serum water containing glucose, maltose, or lactose, none of these sugars were fermented. The culture died out after the second subculture, and I was unable to pursue it further. Clinically, the condition of the knee suggested gonorrhœal arthritis, though the patient had no history of gonorrhœa and he recovered very rapidly indeed under a vaccine of his own germ. It is quite possible that this germ was an unusual form of gonococcus, though its appearance and cultural characters were against this view; while the absence of a history of gonorrhœa and the very rapid recovery also supported the idea that the organism was not a gonococcus.

(2) A patient (Private S.) had what appeared to be a typical attack of acute rheumatism without heart lesions; among the stained slides of the fluid from his left knee one, which had been stained by Leishman's stain, showed a small group of extra-cellular cocci. The citrated joint fluid, after an incubation period of six days, showed a few flocculi on the surface; these were found to be composed of masses of Gram-staining cocci with flattened sides, mostly in pairs, but occasionally in fours. Sub-culture on agar gave a dull white, very sticky growth of cocci arranged in tetrads and in pairs, growth in broth was diffuse and in this medium the arrangement of the cocci in tetrads was well marked. Anaerobic cultures in broth grew feebly after four days' incubation. The patient's opsonic index to the germ was found to be 0·27. He recovered rapidly from this attack, being ill only about four days; but a fortnight later he had a return of pain and swelling, this time in the right knee, and cultures from this joint gave a growth of the same organism as had been obtained from the left knee. This relapse lasted only three or four days, during which his opsonic index to the original culture was found to be 0·74. He was eventually invalided on account of repeated short attacks in other joints. Clinically, the onset resembled that of a moderately acute attack of rheumatic fever, and the patient stated that he had had a previous illness of the same kind some two years before. It may be added that in view of the clinical appearances salicylates were administered, but they seemed to have no effect in staving off the recurring attacks of arthritis. This case might be classed as a tetragenus septicæmia; it was, however, extremely mild for a septicæmia, the patient was never very ill, and his invaliding was due more to the frequency of his relapses than to the severity of the symptoms.

(3) From another case I obtained a culture of a germ similar to

that found in Private S.'s joints. This man had been ill for three days before admission to hospital; he had slight fever only and had arthritis in both knees. The heart was not affected. This was the second attack of the same kind from which the patient had suffered, it only lasted for a very short time, and the man left hospital at the end of ten days, so that I missed the opportunity of taking his opsonic index to the germ, which did not develop in the joint fluid till the eleventh day of incubation. The delay in growth was probably due to the action of a small amount of sodium taurocholate which I had added to the joint fluid with a view to inhibit its bactericidal action. It was noted, however, that compared with its development in other media, there was a considerably slower growth of this germ in joint exudates. This seems to be the case with other germs also, and joint fluid appears to be a poor culture medium for most bacteria.

(4) In two cases I found streptococci in joint exudates, once microscopically only and once after culture. I have already referred to these cases in a previous paper. The case in which the streptococci were found on microscopical examination of the joint fluid was one of moderately severe polyarthritis, but the heart escaped and the patient left hospital fit for duty after a month's stay. The organisms were only found after a very prolonged search, such as I gave to all smear specimens, and I only found two short chains. Cultures of the same fluid were sterile. The case from which I obtained a culture was that of a soldier who was admitted in the first place for fever of an indefinite type, which the officer in charge of the case labelled "influenza." He had been in hospital three or four days before he developed multiple arthritis with pericarditis and valvulitis. He recovered from the clinical symptoms but was left with a damaged heart, and was eventually invalided on this account. In my previous paper I gave reasons for thinking that the streptococcus which I isolated from this case was not identical with that described by Poynton, Paine, Beattie and others.

(5) Lastly, I would refer, with all reserve, to an organism which I have found microscopically under varying conditions and in attempts at culture from six joint fluids and one pleural exudate. All the cases were apparently undoubted rheumatic fever, and in three of them there were heart lesions. These were especially marked in the case from which the pleural exudate was obtained; this patient had multiple transient arthritis, pericarditis and endocarditis, while both pleuræ were inflamed at one time or another. He recovered from the acute symptoms, but was left with a badly

crippled heart. The organism in question is a rod somewhat resembling the diphtheria bacillus in shape, it is generally slightly curved, with rounded ends, and it stains in a beaded fashion; it is usually decolorized by Gram's method, but occasionally, when alcohol has been somewhat sparingly used, a few of the rods may retain the stain. In size it varies from that of a short to that of a medium diphtheria bacillus, and it is almost always found in clumps of five or six bacilli arranged in the same fashion as diphtheria bacilli. In one case I found a small clump of these organisms in a smear from a flake in the joint fluid; they were arranged as described above; there was just one fairly large clump from which a few individuals had apparently broken away when the smear was made. They were somewhat shorter than those found in cultures and, as the film in which they were found happened to be stained by Leishman's stain, I am unable to say whether, in their original condition, they retained Gram's stain or not. In a culture in hydrocele water, peptone, dextrose and glycerine, from the same exudate, the organisms increased for about ten days, apparently growing in the clot at the bottom of the tube; subcultures failed. Seven months later this same patient returned to hospital with a mild attack of "rheumatism," accompanied by inflammation in the tendon sheaths in front of the ankle. I was able to get a small quantity of fluid from the tendon sheaths and again obtained a scanty growth in the clot which formed at the bottom of a tube of peptone broth; subcultures again failed. In a second case the patient was admitted with a sore throat, so severe that quinsy was diagnosed, and an incision was made without, however, finding any pus. The culture from the throat consisted almost entirely of streptococci. He developed an acute arthritis in one knee which, in view of the throat condition, I was inclined to suspect was streptococcal in origin. I failed to obtain any growth of streptococci from the fluid in the joint, but I found, in a specimen taken from the surface of an agar slope, one clump of the bacteria which I have described. I am inclined to think that the germs had not grown, but were simply lying on the surface of the agar slope, which had been inoculated with a fairly large quantity of the exudate. Other cultures from this case failed. This patient passed through a mild attack of "rheumatic fever," the joints affected being the knees, wrists, fingers and shoulders, but the heart was not involved. He had a history of an attack of rheumatic fever four years previously, which lasted two months, and two years later he had a relapse which lasted a week. He recovered

completely from the present attack in twelve days. I have found the same organism in the following cultures taken from a pleural exudate and from four joint effusions:—

(*a*) An aerobic culture on Loeffler's serum which had been incubating for a month, and in a subculture from this into a hydrocele water medium containing hæmoglobin and glycerine, in which it was found after 72 hours.

(*b*) On a blood agar slope after a month's incubation, in a subculture from this into the hydrocele water medium, and in a blood broth tube after a month's incubation.

(*c*) In cultures from two joints and one pleural exudate in a hydrocele water medium containing dextrose, peptone and glycerine. The cultures had been incubated from fourteen to seventeen days, aerobically, and it was in them that I got the nearest approach to a real growth, but even in these the organisms were very few in number and I failed to get subcultures from them.

This communication is, of course, only preliminary in character; I think I have definitely excluded the possibility of the organisms last described being in the dyes or in the media; it is impossible, however, to say more about them until a culture material is found on which they will grow properly. I thought, however, that it might be useful to put the findings on record, since circumstances render it probable that shortly I shall not be in a position to pursue the subject myself. In any case the results of the whole series seem to lend support to my proposition that the term "rheumatic fever" is probably applied to a group of diseases due to a variety of causes rather than to a single disease owning a single causation.

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NOTES OF SOME EXPERIMENTS MADE TO DETERMINE THE RATE OF ABSORBABILITY AND INTENSITY OF ACTION OF QUININE GIVEN HYPODERMICALLY AND BY THE MOUTH, AS SHOWN BY THE MINIMUM-LETHAL-DOSE METHOD.[1]

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In MacGilchrist's able memoir, No. 41 of the Scientific Memoirs of the Government of India, and under the section dealing with the results obtained by minimum and subminimum lethal doses of quinine on guinea-pigs, he states in the summing up of his experiments:—

"The lethality and therefore the absorbability of quinine are in the following order, beginning with the most lethal mode of administration:—

"(1) Subcutaneous injection in extreme dilution (1—50); (2) oral administration during fasting; (3) oral administration with or soon after food; (4) subcutaneous injection in the strengths generally used for hypodermic injections (1 in 2 and 1 in 8)."

In a station like Sierra Leone, where one may be confronted with a case of pernicious malaria at any time, it is naturally extremely important that the method which ensures absorption and action of quinine in the quickest time, short of intravenous injection, should be known and adopted, and it was for this reason that the following experiments were made with a view to confirming MacGilchrist's results.

Monkeys were used instead of guinea-pigs, and the same type of small brown monkey, which is common in the neighbourhood of Free Town, was obtained throughout.

It was decided to investigate principally the effects of quinine taken by the mouth, both during fasting and after food, and to compare the results obtained with those of a series of injections of quinine in strengths of 1—8 and 1—2, the latter being the dilution of the bihydrochloride used, when injections are necessary, at the Military Hospital, Tower Hill. The minimum lethal dose, when given as a 1—8 injection, was first determined and was found to be between 0·2 grm. and 0·25 grm. per kilo of body weight. It is interesting here to note the considerable difference between the minimum lethal dose for guinea-pigs and for monkeys. With this dilution MacGilchrist lays down the dose for a guinea-pig as over

[1] Received for publication October 24, 1912.

0·6 grm. per kilo, as shown in the following table, also taken from his memoir (p. 31).

"The minimum lethal doses, therefore, sufficiently accurate for comparative purposes, are as follows :—

By oral administration (fasting)	.. ..	0·45 grm. per kilo.
,, ,, (after food)	.. ..	0·5 ,, ,,
By subcutaneous injection 1—150	.. ..	0·3 ,, ,,
,, ,, 1—2	.. ..	0·6 ,, ,,
,, ,, 1—8	.. over	0·6 ,, ,,

The following table shows the steps taken to determine the minimum lethal dose in a 1—8 dilution. The first doses were based on MacGilchrist's findings for guinea-pigs.

TABLE I.

INJECTIONS. Dilution 1—8.

Quinine salt	Weight of animal in kilogrammes	Actual dose in grammes	Dose in grammes per kilo animal weight	Results
Sulphate	1·814	1·08	0·6	In convulsions in twenty-five minutes; died one hour after injection.
Sulphate	2·42	0·72	0·3	Weak in forty minutes; convulsions suddenly came on after forty-five minutes; remained unconscious eleven hours; recovered completely in twenty-four hours.
Sulphate	2·8	0·7	0·25	Slight giddiness in twenty-five minutes; marked giddiness in forty minutes; convulsions started in forty-eight minutes; died one hour after dose.
Sulphate	2·6	0·26	0·1	Slightly giddy forty minutes after dose; no further symptoms.
Sulphate	1·36	0·27	0·2	Slight giddiness in thirty minutes; marked in forty minutes; convulsions and unconsciousness began in sixty-five minutes; remained partially unconscious for eight hours; recovered.
Sulphate	2·53	0·44	0·175	Beyond slight weakness and lolling about no symptoms occurred; recovered.
Sulphate	2·6	0·52	0·2	Vomiting and giddiness occurred in forty-five minutes; tremors and marked debility began in one and three-quarter hours; recovered.
Bihydro-chloride	1·43	0·35	0·25	Tremors began in twelve minutes; convulsions and paralysis, especially lower half of body and legs, came on in twenty-five minutes; died in two hours.
Bihydro-chloride	1·4	0·35	0·25	Tremors began in fifteen minutes; these increased; then convulsions with paralysis of hind-quarters occurred in forty-five minutes; partially recovered consciousness, but died twenty-two hours after injection.

From the above results in Table I, I think the minimum lethal dose for monkeys may be taken to be between ·2 and ·25 grm.

per kilo. The next point was to see the effect of this minimum lethal dose when given by the mouth, both in the fasting condition, and also after food had recently been given. To have agreed with MacGilchrist's findings, a smaller dose should have been required to produce as prompt and severe symptoms. The following table shows the results found, and in many cases these experiments and also those of the 1—2 dilution injection, described later, were carried out at the same time as those of the 1—8 series, so as to ensure that the same climatic conditions, food, &c., obtained at the same time for each.

TABLE II.
BY MOUTH AFTER BREAKFAST.

Quinine salt	Weight of animal in kilogrammes	Actual dose in grammes	Dose in grammes per kilo animal weight	Results
Sulphate	1·53	0·306	0·2	No tremors, and beyond lying down occasionally does not look ill; no further symptoms.
Sulphate	1·36	0·27	0·2	Bowels evacuated in ten minutes; vomited after fifteen minutes; no other signs.
Sulphate	2·6	0·52	0·2	Was lying down twenty-five minutes after dose, but no symptoms occurred.
Sulphate	1·36	0·27	0·2	Very slight giddiness after forty-five minutes, which had disappeared in two and a half hours.
Bihydro-chloride	1·4	0·35	0·25	Vomited thirty minutes after dose; very slight tremor one and a half hours after, which was hardly appreciable.
Bihydro-chloride	1·8	0·45	0·25	Beyond looking a little seedy had no symptoms at all.

TABLE III.
BY MOUTH AFTER FASTING EIGHTEEN HOURS.

Quinine salt	Weight of animal in kilogrammes	Actual dose in grammes	Dose in grammes per kilo animal weight	Results
Sulphate	1·53	0·3	0·2	No symptoms.
Sulphate	2·6	0·52	0·2	Lying down directly after dose; no symptoms.
Sulphate	1·36	0·27	0·2	Slightly shaky in thirty minutes; no further symptoms occurred.
Sulphate	1·36	0·27	0·2	No symptoms at all.
Bihydro-chloride	1·4	0·35	0·25	No symptoms at all.
Bihydro-chloride	1·07	0·43	0·4	Was swaying about after twenty minutes; after one hour this had lessened; after one and three-quarter hours was much better and hungry; ate food; no further symptoms.

In comparing the results of equal doses given by the mouth and by injection, it is seen that doses which will produce grave

symptoms or death by injection (1—8 dilution) will produce very little effect when given by the mouth, the last animal of the series receiving no less than 0·4 grm. per kilo with not at all a severe reaction. This result is contrary to that obtained by MacGilchrist with guinea-pigs.

Injections of 1—2 dilution were next tried on two monkeys, with the results as shown in Table IV.

TABLE IV.
INJECTIONS. Dilution 1—2.

Quinine salt	Weight of animal in kilogrammes	Actual dose in grammes	Dose in grammes per kilo animal weight	Results
Bihydro-chloride	1·C	0·25	0·25	Slight tremor in one hour; marked tremor in one and a-half hours; slight tremor after six hours; no further symptoms.
Bihydro-chloride	1·3	0·39 (0·4)	0·3	Faint tremors began in thirty-five minutes; marked tremors present in seventy-five minutes; convulsions and unconsciousness began suddenly in one hour and twenty minutes; ten minutes later (one hour and thirty minutes) was sitting up quite conscious; no further symptoms occurred and it recovered.

The results obtained in this dilution agree with those of MacGilchrist.

A final series of three monkeys was then taken, and each was injected as nearly as possible at the same time. They all had the minimum lethal dose which had been found for monkeys when using a 1—8 dilution (0·25 grm. per kilo) but were given the dose in the following dilutions, 1—5, 1—3 and 1—2. This was done to find out if as quick and as severe effects could be produced with a lower dilution than 1—8, and in order to make the injection less bulky.

The results obtained are shown in Table V.

This table shows time of onset and the nature of the symptoms in three monkeys which had received injections of 0·25 grm. of quinine per kilo (minimum lethal dose 1—8) in dilutions of 1—2, 1—3 and 1—5 respectively.

It will be seen that the monkey which received the 1—2 dilution developed symptoms, especially convulsions, more quickly than those shown in Table IV. The explanation is, I think, as follows: The monkey was a very restive one and to get it into a certain place, about half an hour after its injection, it was much handled and struggled considerably. Immediately after this movement,

which was to replace it in a cage, convulsions started; and I presume that the movement caused a sudden large outflow of quinine from the site of the injection into the general circulation. I have noticed this to occur in several cases, and I think it may be a point of practical value where rapid absorption after injection in a severe malarial case is urgently required, and could be induced by rubbing the site of the injection or making passive movements with the injected limb.

TABLE V.

Symptoms	Dilution 1—5	Dilution 1—3	Dilution 1—2
Tremors ..	Began in nine minutes	Began in twelve minutes	Began in twenty-three minutes
Giddiness ..	,, seventeen minutes	,, twenty-four minutes	,, thirty minutes
Vomiting ..	,, seventeen minutes	*Nil*	,, one minute
Convulsions	,, twenty minutes	Began in thirty-nine minutes	,, thirty-three minutes
Death ..	Died in twenty-five hours	—	—
Recovery, &c.	The convulsions continued and it lay in a paralytic condition eleven hours. It recovered consciousness, but died twenty-five hours after the the dose	The convulsions continued for about half an hour, and about one and a half hours after its dose it was recovering; in about six hours it was nearly well and eating food	The convulsions and unconsciousness alternated with consciousness; it soon began to sit up in the interval, and six hours after its dose was almost well and eating food.

It will be seen that the results obtained with a 1—5 dilution were very nearly the same as those with the 1—3 dilution (Table I). Sufficiently so, I think, to make this dilution one of practical value, as its bulk is only slightly over half that of the 1—8 dilution.

All the injections were given in the flank behind the shoulder.

Administration by the mouth was performed by inserting a small wooden gag and then injecting the dose into the back of the fauces with an ordinary glass syringe. With regard to the local effect of the injections, in only one case, *e.g.*, the second injection on Table I, was there loss of hair followed by sloughing of the skin, the area being about half-a-crown in size, at the site of the injection.

Before attempting to summarize the above results, I must own that I do not agree with MacGilchrist in his wholesale condemnation of quinine injections, whether subcutaneous or intramuscular, as stated in his summary of results. I have used, and seen used, the injection method a considerable number of

times both in this country (Sierra Leone) and in India. Beyond a little temporary local pain and stiffness sometimes following an injection, I have not seen any unfavourable local or general results occur from it.

I cannot agree with his statement that "subcutaneous and intramuscular injections in solutions of the usual strength (1—2 to 1—8) are inferior to quinine by the mouth in 'rapidity of action and thoroughness of absorption.'" I have repeatedly seen cases of malignant tertian infection which have resisted quinine given by the mouth, no vomiting being present, and have yielded to the same dosage by injection. I have known cases which have had more than one attack of malaria ask to have injections administered in preference to mouth treatment, as they had received better and quicker results from it in former attacks. Further, the class of case which has early vomiting, and it is fairly often seen, is certainly in my experience more advantageously treated by injections. With regard to the results recorded above, it will be seen that marked differences exist between the monkey and the guinea-pig. The monkey more nearly resembles man in the amount of the dose which is fatal. Taking the acknowledged fatal dose for an adult as about 4 dr., and also taking the minimum lethal dose of a 1—8 or 1—5 dilution to be about 0·25 grm. per kilo of monkey, it will be noticed that the doses closely approximate. A 10-stone man receiving quinine in the proportion of 0·25 grm. per kilo will get about 4·08 dr., whereas if he were given the mimimum lethal dose for a guinea-pig (1—8 dilution) he would get over 9·8 dr. I think it may be accepted, therefore, that the monkey more closely resembles man in his reaction to quinine than the guinea-pig does.

In conclusion, it will be seen from the above tables that the mode of administration giving the quickest action and the best absorption of quinine in monkeys is as follows, commencing with the most efficacious :—

(1) Injections of 1—8 dilution.
(2) ,, 1—5 ,,
(3) ,, 1—3 ,,
(4) ,, 1—2 ,,
(5) Oral administration with or without fasting.

The actual minimum lethal dose for the oral administration methods and that for the low dilutions by injections, have not been established, because, as stated at the beginning of these notes, the object of these experiments was to throw further light on the much debated question as to which method gives the quickest and most thorough result, oral administration or injection.

SOME OBSERVATIONS ON THE BACTERIOLOGY OF INCINERATOR SMOKE AND ASH.[1]

By Captain J. J. H. NELSON.
Indian Medical Service.

The steady development of incineration in Indian cantonments as an economical and efficient method of night-soil disposal has, as might be expected, aroused a certain amount of opposition. Some of the objections raised have an undoubted justification, while others are mainly loose statements based on uncertain facts, and directed to arouse hostility on the plea that incineration, as carried out, transgresses the principles which animate scientific preventive medicine. Among these statements is one which has gained much credence and which, if true, would go very far to weaken the case in favour of incineration. This statement is to the effect that incineration is so imperfectly carried out that the smoke and ash from the incinerators contain fæcal micro-organisms, and that consequently the procedure is an unsafe method of night-soil disposal. To test the accuracy of this allegation, I have carried out certain experimental observations; their publication seems to me desirable. The experiments were made in Bangalore, using an incinerator of simple construction, which may be best described as a modified "Sialkot." It was made with mud walls and roof, surmounted by a short chimney, and provided with two layers of grate bars. This incinerator represented quite a crude type and far more primitive than most of those with which incineration is usually carried out. The results which I have obtained with so primitive a design should go far to allay fears which have been aroused as to the survival of fæcal and pathogenic micro-organisms in materials and products subjected to and derived from ordinary incinerators.

(I) *Experiments with Petri Dishes containing Conradi-Drigalski Medium.*—For the purpose of obtaining good results the following plan was decided upon. Petri dishes 4½ in. in diameter, containing Drigalski-Conradi medium were exposed for varying intervals at different distances from the incinerator. The plates were exposed by removing their lids and allowing the smoke to blow on to the surface of the medium. At the same time control plates were exposed, well away from the incinerator, in the station hospital

[1] Received for publication October 14, 1912.

compound for the same length of time as the plate exposed in the incinerator smoke. In this way one was enabled to judge to what greater extent *Bacillus coli* was present in the vicinity of the incinerator than in the open fields. I have tabulated the results as follows:—

No. of experiment	Date	Distance from incinerator	Duration of exposure	Control plate. Number of colonies of *B. coli* present		Incinerator plate. Number of colonies of *B. coli* present		Comments
1	20.8.10	3 yards	5 minutes	2		1		*August* 20, 1910.—Dry day. Moderate breeze from the N.E. Fair amount of dust flying.
2	20.8.10	3 ,,	10 ,,	1	7	3	8	
3	20.8.10	3 ,,	15 ,,	4		4		
4	20.8.10	10 ,,	5 ,,	1		1		*Control plates were about* 400 *yards from incinerator.*
5	20.8.10	10 ,,	10 ,,	1	5	2	5	
6	20.8.10	10 ,,	15 ,,	3		2		
7	21.8.10	20 ,,	5 ,,	0		2		*August* 21, 1910.—Dry day. Less dust flying. Slight breeze. Control plates as before.
8	21.8.10	20 ,,	10 ,,	3	6	1	7	
9	21.8.10	20 ,,	15 ,,	3		4		
				Total, 18		Total, 20		

From this table it will be seen that three plates 3 yd. from the incinerator contained a total of *8* colonies of *B. coli* as against *7* colonies on the three control plates exposed in the open. This gives only an excess of *1* colony, and considering the large amount of litter, &c., near the incinerator plates the excess is very little. At 10 yd. distance from the incinerator the three plates contained a total of *5* colonies as against *5* on the controls—no excess. At 20 yd. the incinerator plates contained a total of *7* colonies as against *6* in the controls—an excess of *1*. On the whole series of experiments the incinerator plates contained a total of *20* colonies of *B. coli* as against *18* on the controls—only a difference of *2* colonies. The following reactions show that the *B. coli* of Escherich was present:—

Lactose	Saccharose	Dulcit	Adonit	Inulin	Proskauer	Motility	Gram	Litmus milk
+	−	+	−	+	−	+	−	+

(II) *The second series of experiments* was carried out as in I, but was much more interesting. The *B. coli communis* is so commonly present in dust, &c., that I determined to attempt the isolation of *B. typhosus* from the incinerator smoke. For this purpose I noted four typhoid patients from whose stools I had isolated *B. typhosus*

on August 22, four days previously. On August 26 the stools from the same patients were brought to the incinerator in closed receptacles, no disinfectant having been added. Four specimens were taken from these stools and *B. typhosus* was found on examination to be still present. There was, therefore, no doubt that *B. typhosus* was present when these four stools were placed in the incinerator. The following is a tabular statement of results :—

No. of experiment	Date	Distance from incinerator	Time elapsed since placing stool on fire	Duration of exposure of plate	Number of *B. typhosus* colonies isolated	Comments
1	26.8.10	5 yards	5 minutes	5 minutes	Nil	
2	26.8.10	5 ,,	10 ,,	10 ,,	,,	*August* 26, 1910.—Dry day. Slight wind from S.W.
3	26.8.10	10 ,,	15 ,,	15 ,,	,,	
4	26.8.10	10 ,,	20 ,,	15 ,,	,,	
5	26.8.10	20 ,,	25 ,,	20 ,,	,,	

Control plates were set up as before, but, as was to be expected, no *B. typhosus* colonies grew on any of them.

(III) *Experiments to isolate B. coli communis from Smoke by Washing the Smoke in Sterile Tap-water.*—My next series of experiments was directed towards an attempt to isolate the *B. coli communis* from incinerator smoke by aspirating the smoke through bottles containing sterile tap-water and thus washing it. The diagram below will render the description easy to follow. A glass funnel F was attached to bottle A by 6 ft. of rubber tubing. Bottle A was similarly attached to bottle B and B to C. Bottles A, B, and C each contained sterile tap-water, the capacity of A and B being 2 litres and of C 4 litres. Bottle C was for syphoning purposes.

The whole apparatus was sterilized and carefully carried to the incinerator. A piece of iron was attached to the glass funnel as a handle and the funnel passed inside the incinerator door. I was afraid the heat might melt the rubber tubing, but it did not do so.

A clip at D was then opened and 4 litres of water in bottle C were syphoned out. This took seven minutes to complete. As a vacuum was created in bottle C suction was exerted on B and then on A. Smoke was thus drawn through the funnel F into bottle A. It then passed through the sterile tap water in A to B and thence through the sterile water in B to C, being twice washed in transit. Smoke could be seen in the bottles, so there was no doubt as to its passage through them. Of course, it does not follow that 4 litres of smoke passed through each bottle A and B. The amount passing is not of great importance so far as the object of the experiment is concerned, which was to trap *B. coli* in the water in bottles A and B. When syphonage was completed bottles A and B were at once taken to the Brigade Laboratory and samples of water examined for *B. coli*. The results were as follows :—

	Date	Total colonies in 1 c.c. on agar	Lactose fractors	*B. coli* of Escherich	Comments
Bottle A ..	27.8.10	5	Present in 20 c.c.	Present ..	None of the 5 colonies on agar were *B. coli*.
Bottle B ..	27.8.10	0	Not present in 40 c.c.	None found..	

From this table it is seen : (1) That by washing smoke as many as five colonies per cubic centimetre were added to sterile tap-water in bottle A, but none reached bottle B.

(2) Lactose fractors were present in 20 c.c. of bottle A water, but none in up to 40 c.c. of bottle B water.

(3) These lactose fractors were found on further examination to belong to the *B. coli* group.

(IV) *An attempt to isolate B. typhosus*, using the apparatus as in Experiment III. Stools from which the *B. typhosus* had been isolated were put into the incinerator and five minutes after placing them there smoke was aspirated as before through bottles A and B. The results were as follows :—

	Date	Total colonies in 1 c.c. on agar	Lactose fractors	*B. typhosus*	Comments
Bottle A ..	29.8.10	4	Present in 30 c.c.	Not found ..	None of the 4 colonies on agar were *B. typhosus*.
Bottle B ..	29.8.10	0	Not present in 40 c.c.	Not found ..	

(V) *Examination of Fresh Ash from Incinerators.*—The last series of experiments was carried out with fresh ash from under the incinerator bars. The following plan was adopted. On August 27 five tubes of MacConkey's neutral red bile salt lactose broth were taken to the incinerator and each one inoculated with a loopful of fresh ash by thrusting a sterile platinum loop into the undisturbed ash. No change occurred in any of the tubes. Subcultures on agar and Drigalski-Conradi media gave no growth.

On August 30 this experiment was repeated. In order to ensure the adhesion of ash to my platinum loop I first sterilized it, then wet it by thrusting it into sterile tap-water and then put it into undisturbed ash. Each tube was inoculated in turn in this way, but all five remained sterile. This pointed to the fact that so high a temperature had been attained during incineration that all organisms were killed.

This ended my series of observations, and as a result of them I made the following conclusions :—

(1) That smoke from an incinerator is not a source of danger to persons in its vicinity.

(2) That a properly managed incinerator is a sure and safe method of rapidly disposing of night-soil.

(3) That the ash from an incinerator is not a source of danger if blown about, but merely a nuisance.

(4) That incineration is well suited for disposing of infected stools and deleterious matter and when properly supervised can destroy all night-soil and refuse with a minimum of labour and maximum of safety.

Clinical and other Notes.

LEPROSY AND THE BED-BUG.[1]

By Captain D. S. SKELTON,
Royal Army Medical Corps,
AND
J. G. PARHAM,
Government Bacteriologist, Zanzibar.

For many years, insects and biting flies have been suspected of being the carriers of the infecting agent of leprosy. *Chlorops lepræ, Sarcoptes scabei, pediculi,* mosquitoes, and bed-bugs have all been suggested. Castellani states that natives of Ceylon say that the disease begins after a bite by a rat.

It was after reading Sandes' work, published in the *Journal of Tropical Medicine and Hygiene,* that we determined to see if we could find acid-fast bacilli in the bed-bugs taken from the beds of the lepers in the Government Asylum in Zanzibar.

Sandes found acid-fast bacilli in twenty out of seventy-five bugs examined. His method was to starve the insect for a period of from twenty-four hours to twenty days, and then to allow the hungry insect to feed on leprotic tissue. The acid-fast bacilli were found in the alimentary canal. Long, also in Basutoland, reported that he found bacilli which morphologically resembled the *B. lepræ* in the bed-bug. He found them in every bug "that bit freely." He thinks that infection may have occurred from the bites of an infected bug. Sandes' experiments with an exceedingly hungry bed-bug, and Long's where the bug was deliberately placed on a leprotic patch, seemed to us rather artificial conditions.

We wished to ascertain if the ordinary bed-bug taken directly from the bed of a leper did or did not harbour acid-fast bacilli.

The following are the details of the experiments:—

Experiment 1.—Seventy-five bed-bugs (*Cimex lectularius*) caught on beds at Walezo Leper Asylum were teased out, and their intestinal contents examined microscopically for acid-fast organisms.

The technique employed was as follows:—

Live bugs which had been caught on several beds in the Leper Asylum were placed in sterile tubes and washed for several hours in many changes of normal saline. The intestinal contents were teased out and films were made of their contents and stained by the Ziehl-Neelson method, and decolorized for five to ten minutes in 2 per cent. sulphuric acid.

[1] Received for publication November 20, 1912.

Acid-fast granules were found in one such preparation. They gave one the impression of the large *azure granules* in a large mononuclear leucocyte, but although the film was searched very carefully for several hours on two or three days, no further patches of acid-fast granules could be detected.

In two films, stained clumps of bacilli that were neither pink nor blue, were seen. They were arranged somewhat like *B. typhosus* in the spleen. It was thought that these organisms might have been slightly acid-fast bacilli, and that a 2 per cent solution of sulphuric acid had only partially decolorized them.

One of the films therefore was restained with carbol-fuchsin and decolorized in 5 per cent sulphuric acid in methylated spirit for ten minutes, and counterstained with methylene blue. On examination a few pink rods could be made out, but the majority were stained as in the first specimen. The rest of the film had completely lost the pink stain in the decolorizing fluid. (*Note.*—One of us (J. G. P.) had previously made a systematic examination of 500 bugs without once finding acid-fast bacilli).

Experiment 2.—100 live bed-bugs caught at Walezo were washed in sterile normal saline by repeatedly shaking them up in two tubes for several hours. The fluid was then poured off and centrifugalized. Several films were made of the deposit and were stained with carbol-fuchsin and decolorized in 5 per cent sulphuric acid in methylated spirit for ten minutes. No acid-fast organisms were detected after careful search for several hours. What was left after the fluid had been decanted, that is to say the bodies, legs and arms of the bed-bugs, were put into a mortar and ground up to a powder. Several films of this were stained and examined. No acid-fast organisms were seen.

It may be remembered that Much in his description concludes that the tubercle virus exists in three forms: (1) An ordinary bacillary form; (2) a non-acid-fast form showing granules in its interior, and (3) free granular forms. It may of course be possible that the granules we saw and the indeterminate bacilli were forms of the ordinary acid-fast *B. lepræ*.

Conclusions.—(1) With the above exception it does not appear that the ordinary common bed-bug harbours any bacilli which morphologically resemble the *B. lepræ*.

(2) In these circumstances it does not appear probable that the bed-bug plays any great part in the transmission of the disease in Zanzibar.

POISONING BY PRUSSIC ACID.

By Major E. A. BOURKE.
Royal Army Medical Corps.

Attempted suicide by hydrocyanic acid is sufficiently rare in the Service to justify my forwarding the following notes of a recent case.

About 9.30 p.m., October 30, 1912, Private T. attempted suicide in his barrack room by swallowing 2 dr. acid hydrocyanic dil. B.P.; almost immediately afterwards he fell on the floor, and a comrade observing his condition immediately called Serjeant Harper and Corporal Mayes, R.A.M.C., who happened to be in the adjoining room. Serjeant Harper reported: "I found Private T. lying on the floor in a rigid, doubled-up condition; he was just able to inform me, with much struggling to breathe properly, that he had taken 2 dr. of prussic acid, as he wanted to die. I immediately applied cold effusions to head and neck, and sent at once for an antidote (precipitated oxide of iron and magnesia carbonate), and with assistance kept up artificial respiration.

In the meanwhile the other N.C.O. notified me on the telephone (fortunately there is a telephone in the barrack room). I ordered the artificial respiration to be continued and an emetic to be given, and arrived shortly afterwards. The patient's condition on my arrival appeared so critical that I did not regard his recovery as possible; he was convulsed, the pulse at the wrist was imperceptible, his face was livid and congested, the pupils were dilated, respirations convulsive, and the breathing appeared to cease for some seconds at a time, his breath smelling strongly of prussic acid. Artificial respiration and douching were kept up. I gave at once atropine gr. $\frac{1}{80}$ hypodermically, with inhalations of amyl nitrite; the pulse improved somewhat. As the emetic had not acted well, I used the stomach pump, but owing to the rigidity of the jaws and the occurrence of convulsions, I had to withdraw the tube; this was followed by slight vomiting. Repeated doses of iron and magnesia carb. were given. A catheter was passed and urine withdrawn.

His pulse failed on several occasions and he had repeated attacks of convulsions with muscular rigidity and foaming from the mouth; hypodermic injections of atropine with inhalations of amyl nitrite were followed on each occasion by improvement in the pulse and more natural breathing. After about two hours he became conscious and from this time he made a rapid recovery.

While in hospital the following day, the patient, an intelligent and well-educated orderly, wrote out for me a statement of his symptoms as follows: "I swallowed 2 drachms of hydrocyanic acid obtained from a local chemist; a few seconds after swallowing it my breathing became deep and convulsed, followed by violent contraction of the whole of my muscular system, especially of my jaws. I then became semi-conscious, my head and face felt very heavy and congested; I very shortly after

became unconscious. I recovered as from ordinary sleep, but not feeling fresh or strong."

Stevenson[1] states "that the largest dose from which an adult has recovered was probably in a case reported by Burman in the *Lancet*. In this case 1 fluid drachm of prussic acid was taken in mistake; treatment was at once adopted and within half an hour consciousness returned, followed by quick recovery, and he sums up—from the facts observed we may assume that a quantity of B.P. acid (of 2 per cent.) about 50 gr. (*i.e.*, 1 gr. of anhydrous acid) would commonly suffice to destroy life in an adult. When the dose is 2 drachms and upwards, death takes place in two to ten minutes."

The chief point of interest in this case depends on the quantity of prussic acid taken; it seems almost incredible that recovery should take place after taking 2 fluid drachms of prussic acid, *i.e.*, over 2 gr. of anhydrous acid, yet a 2-drachm bottle, corked and containing only two or three drops of liquid smelling of prussic acid, was found by the side of the patient after he became unconscious, and on recovery the patient was most emphatic in his statement that he had swallowed the full contents of this bottle, and that he had procured this quantity (2 drachms) from a local chemist. I think there is no reason for doubting that 2 drachms were taken, and this is further supported by the acute onset, the symptoms of poisoning occurring almost immediately, and moreover, in all probability a fatal termination would have rapidly ensued were it not for the prompt and correct treatment adopted in the first instance by the two intelligent Royal Army Medical Corps N.C.O's, who, fortunately for the patient, happened to be in the adjoining room.

OBSERVATIONS ON THE VALUE OF CERTAIN CHEMICALS FOR THE STERILIZATION OF WATER, MADE UNDER THE SUPERVISION OF CAPTAIN W. R. GALLWEY IN THE 9TH (SECUNDERABAD) DIVISION LABORATORY.

By Private F. C. BOULTON.
Sherwood Foresters.

The following experiments were undertaken with a view to confirming the work of other observers on the value of chloride of lime and potassium permanganate as a means of purifying water for troops in the field.

Chloride of Lime.

Commercial chloride of lime purchased from a local chemist was used. Before commencing the experiment the powder was examined for free chlorine by the silver nitrate method and found to contain 0·3 part of free chlorine in 1 grm. of the powder.

[1] Medical Jurisprudence Taylor.

A solution was made with 10 c.c. distilled water and 3 grm. of chloride of lime. This gives 0·3 part of free chlorine to each cubic centimetre of solution.

The technique employed was as follows:—

A pail containing 10,000 c.c. of water contaminated with fæces, or water from a grossly foul stream, was used. In every case a control plate was made before adding the reagent. A fine capillary pipette was marked so that the amount of water taken for each plate should be as accurate as possible. Neutral red bile salt agar tubes were melted, and the water added at 42° C., the tubes poured into sterile Petri dishes, allowed to set, and incubated at 37° C.

As Nasmyth and Graham found that free chlorine in the proportion of 0·3 part per million was sufficient to sterilize water from a lake, 0·003 c.c. of the solution of chloride of lime was used in the opening experiments. This amount gives 0·3 part of free chlorine per million of water.

Experiment 1.—Tap water contaminated with fæces. Control plate: Too crowded to count. After ten minutes' contact with Cl.: Lactose fermenters present. After twenty minutes' contact with Cl.: Lactose fermenters present.

Experiment 2.—Stream water without fæces was used in this experiment, and the time of contact lengthened. Control plate: 800 lactose fermenters per cubic centimetre. After twenty minutes' contact: 500 lactose fermenters per cubic centimetre. After thirty minutes' contact: 400 lactose fermenters per cubic centimetre.

Experiment 3. — Laboratory tap water inoculated with *Bacillus typhosus*. Control plate: Numerous *B. typhosus* colonies. After ten minutes' contact: Numerous *B. typhosus* colonies. After twenty minutes' contact: Numerous *B. typhosus* colonies. The *B. typhosus* colonies were subcultured on agar and incubated for twenty-four hours, then put through the various sugars. Sugars gave *B. typhosus* reactions.

It was then decided to compare the value of chloride of lime with acid sodium sulphate in the proportion of 15 gr. of the latter salt to a pint of water. The acid sodium sulphate contained 24 per cent free H_2SO_4. The technique was the same except that a pint of water was removed, and 15 gr. of the acid sodium sulphate added. The remaining water in the bucket (10,000 c.c.) was treated with chloride of lime as before.

Experiment 1.—Stream water used. Control plate: Too crowded to count. Acid sodium sulphate plate after thirty minutes' contact: 80 colonies. Chloride of lime plate after thirty minutes: Reduction not so marked as on acid sulphate plate.

Experiment 2.—Stream water used. Control plate: Too crowded to count. Acid soda sulphate after thirty minutes: 8,400 colonies per cubic centimetre. Chloride of lime after thirty minutes: 12,600 colonies per cubic centimetre.

Experiment 3.—Stream water used (after heavy rains, so water filtered roughly). Control plate: 2,270 colonies per cubic centimetre. Acid sulphate after thirty minutes: 1,400 colonies per cubic centimetre. Chloride of lime after thirty minutes: 1,740 colonies per cubic centimetre.

Experiment 4.—Laboratory tap water inoculated with *B. typhosus*. Control plate: *B. typhosus* present. Acid sulphate after thirty minutes: *B. typhosus* present. Chloride of lime after thirty minutes: *B. typhosus* present. Colonies put through sugar: *B. typhosus*.

Experiment 5.—Laboratory tap water inoculated with *B. typhosus*. Control plate: *B. typhosus* present. Acid sulphate after thirty minutes: *B. typhosus* present. Chloride of lime after thirty minutes: *B. typhosus* present. Colonies put through sugars: *B. typhosus*.

Experiment 6.—Laboratory tap water contaminated with urine. The time of contact increased to one hour. Control plate: 900 colonies per cubic centimetre. Acid sulphate after one hour: 700 colonies per cubic centimetre. Chloride of lime after one hour: 700 colonies per cubic centimetre.

Experiment 7.—In this experiment the water was contaminated with the urine of an enteric convalescent who is a chronic carrier of *B. paratyphosus* A. Control plate: Showed six lactose fermenters and only one *B. paratyphosus* A colony. Acid sulphate and chloride of lime after thirty minutes: no *B. paratyphosus* A colonies. This was probably due to the small amount of *B. paratyphosus* A in the urine.

Experiment 8.—No. 7 experiment repeated, using the carrier's urine. Control plate: 23,000 *B. paratyphosus* A colonies present per cubic centimetre. Acid sulphate after one hour: 2,000 *B. paratyphosus* A colonies present per cubic centimetre. Chloride of lime after one hour: 5,000 *B. paratyphosus* A colonies present per cubic centimetre. Colonies through sugars: *B. paratyphosus* A.

Experiment 9.—In this experiment the amount of chloride of lime was increased to 0·5 part per million. Control plate: 1,700 colonies per cubic centimetre. Acid sulphate after one hour: 150 colonies per cubic centimetre. Chloride of lime after one hour: 220 colonies per cubic centimetre.

Experiment 10.—As in No. 9, using 0·5 part of chloride of lime per million. Control plate: 530 colonies per cubic centimetre. Acid sulphate after one hour: 370 colonies per cubic centimetre. Chloride of lime after one hour: 510 colonies per cubic centimetre.

Potassium Permanganate.

Potassium permanganate was used in the following experiments in the proportion of ½ gr. to a gallon of water:—

Experiment 1.—Laboratory tap water + fæces. Control plate: Lactose fermenters present. After half an hour's contact: Lactose fer-

menters present. After one hour's contact: Lactose fermenters present. Some of the lactose fermenters were put through sugars and proved to be: *B. neapolitanus*, and B. No. 74 in Clemesha's classification.

Experiment 2. — Laboratory tap water + fæces. Control plate: Lactose fermenters present. After half an hour's contact: Lactose fermenters present. After one hour: Lactose fermenters present. Some of the lactose fermenters were put through sugars. Sugars: *B. neapolitanus* and B. No. 74.

Experiment 3. — Laboratory tap water + urine from a "chronic" carrier of *B. paratyphosus* A; time of contact lengthened. Control plate: *B. paratyphosus* A present. After one hour: *B. paratyphosus* A present. After two hours: *B. paratyphosus* A present. Colonies from 2-hours' plate were put through the sugars and the absorption test: *B. paratyphosus* A was present.

Experiment 4.—Laboratory tap water + fæces. Potassium permanganate increased to 1 gr. per gallon of water. Control plate: Lactose fermenters present. After forty-five minutes: Lactose fermenters present. After one hour: Lactose fermenters present.

Conclusions.

(1) Free chlorine in the proportion of 0·3 or 0·5 part per million was found insufficient to sterilize water contaminated with fæcal matter.

(2) Some reduction of the number of fæcal organisms present was obtained, but the amount was insignificant.

(3) Free chlorine in the above proportion is less valuable as a purifying agent than the acid sodium sulphate.

(4) Potassium permanganate in the proportion of ½ gr. per gallon did not sterilize water contaminated with fæcal matter.

(5) None of the three reagents used—i.e., chloride of lime, acid sodium sulphate, potassium permanganate—was able to kill off *B. typhosus* or *B. paratyphosus* A.

(6) It was found that inoculating melted neutral red lactose agar at 42° C. gave more accurate results than when cold plates were inoculated by smearing the surface with a glass rod. In the former method colonies were more distinct, and grew more luxuriantly.

References.

Journal of the Royal Army Medical Corps, vol. xvii, No. 1, p. 50.
Ibid., vol. xviii, No. 5, p. 513.

A CASE OF INFECTIVE GRANULOMA NECESSITATING CÆSAREAN SECTION.

By Captain A. G. WELLS.
Royal Army Medical Corps.

A native woman, aged 27, was brought to me at the hospital at Kasauli on September 4, 1912, said to be suffering from "obstructed labour." She was a primipara at full term, and was said to have been in labour four days. On examination the whole of the vulva, perineum, and anus were found to be involved by an infective granuloma; the disease extended up on to both groins and buttocks. The vagina was so narrowed by scar tissue, that it was with difficulty that two fingers could be introduced. Part of the vaginal mucous membrane was sloughing and there was a foul-smelling discharge from the whole of the infected area. The general condition of the patient was good, which made the history of four days' labour somewhat doubtful. Examination elicited the fact that the head was presenting and the os patulous and about one-fifth dilated. The case was seen by Lieutenant-Colonel M. P. Holt, R.A.M.C., and it was decided that the only possible way of delivering a living child was by Cæsarean section, and that, as the condition of the vulva and vagina was not likely to improve, the growth being too extensive for removal, Porro's operation should be done at the same time.

The patient was given a hot bath and having been anæsthetized with chloroform and the abdomen painted with 1 per cent iodine and spirit, an incision was made and within four minutes the child was handed to a medical officer waiting to receive it. Up to this time no attempt had been made to check hæmorrhage, but now the bleeding points were secured and hysterectomy completed. The ovaries and appendages were not removed. The abdominal wall was closed without drainage. Considering the nature of the operation there was comparatively little hæmorrhage and the patient stood the operation well. The child was somewhat blue at first but quickly recovered. On return to the ward the patient was given a saline and brandy enema. In the evening her temperature rose to 101°, pulse 128, and the abdomen was distended. She was ordered ½ oz. of castor oil. This had no effect, and the following morning her temperature was 102°, pulse 128. She was ordered another ½ oz. of castor oil and an enema every four hours until a good action of the bowels was obtained. This had no effect until the following day when she had eight stools which relieved the distended condition of the abdomen, and her temperature dropped to 99·4°, pulse 115. The next day her temperature was 99.6°, pulse 104, the abdomen quite soft, and she seemed quite comfortable. The following day her temperature rose again and remained up for some seven days. This, I think, was solely due to the condition of the vulva, &c., from which a foul discharge was still coming; carbolic fomentations every four hours were ordered and

o days of this treatment her temperature fell to normal and l so during the rest of her stay in hospital.

stitches were removed on the eighth day, when the wound was healed. She left hospital at her own request on the eighteenth r the operation apparently quite well.

E ON THE "CARRIER" IN PARATYPHOID FEVER.

By Captain J. L. WOOD.

Royal Army Medical Corps.

accompanying photograph of a Conradi-Drigalski plate, showing culture of *Bacillus paratyphosus* A, throws some light on the ism by which typhoid fever is spread by the "carrier." The was obtained by the passage of the fingers of a chronic urine

over the media, after the man had micturated and adjusted his The man was not told what was going to be done, and he could shed and dried his hands prior to leaving the lavatory had he ed. Major Herrick, R.A.M.C., very kindly photographed the me.

Reports.

EXTRACT FROM THE REPORT, BY LIEUTENANT-COLONEL M. T. YARR, R.A.M.C., MEDICAL INSPECTOR OF RECRUITS, SCOTTISH COMMAND, FOR THE YEAR 1911.

Medical Inspection.

Medical Inspection of Recruits.—The work of the Medical Inspector, as distinguished from that of the Medical Examiners, falls under two headings: Recruits and Recruiting.

(A) *Recruits.*—Every recruit in the Command is seen once a month (with the exception of those at the Paisley Special Reserve Depot, who are only seen once in two months); and with occasional exceptions, such as Regular recruits who have already served in the Special Reserve, no man's medical history sheet is stamped by the medical inspector till he has been seen twice.

The most interesting and satisfactory work in connexion with this duty is in prescribing appropriate physical exercises for individual cases, and nursing "borderland" cases in various ways into efficiency (see Training). A subsidiary, though important part of the medical inspector's work, is recommending men for discharge on Army Forms B 204 and E 517; this subject will be entered into in detail later under the heading "Causes of Discharge." I am glad to be able to draw attention to the greatly decreased leakage from the Army from this cause during the present recruiting year; I never sign these Army forms without the feeling that, except in post-enlistment disabilities, they are a record of failure—failure in the sense of want of care in the medical examination; failure, perhaps, in patience and perseverance on the part of the medical inspector.

(B) *Recruiting.*—The second important branch of the medical inspector's work is the instruction of medical examiners of recruits, and co-ordinating their work in general.

These conferences are valuable in every way, and can only be replaced very inadequately by written communications. I am not in favour of sending out unauthorized glosses on the regulations for the examination of recruits; the official regulations, supplemented by personal instruction, are ample, and medical examiners of recruits are very apt to consider circulars from the medical inspector in the light of substitutes for regulations instead of supplements. My experience is that the best work is obtained from recruiting stations when medical examiners regard the medical inspector as a colleague and friendly adviser; I am far from saying that severe and even minatory criticism is not occasionally necessary, but I am glad to say such occasions become fewer and fewer here;

severe strictures may easily be pushed too far and produce the very undesirable result of an abnormally high rejection rate. When all is said and done, the homely phrase, "Get and keep recruits" (with, of course, the implied reservation that they must be potential efficient soldiers), expresses succinctly the guiding principle of all engaged in recruiting work.[1]

Medical Inspector's Diary and Index Book.—The careful daily upkeep of his Diary is a very essential part of the medical inspector's duty; to anyone unfamiliar with recruiting in Scotland many of the details entered in this Army Book here may seem trivial and meticulous, but experience shows the necessity of keeping an accurate record of seemingly unimportant occurrences, details as to recruits, &c.; questions constantly crop up, and the Diary often proves an invaluable work of reference when chapter and verse in support of some decision are suddenly called for. The Index Book of Army Forms B 204 and E 517, initiated by my predecessor, is a particularly useful supplement to the Diary.

Territorial Recruits.—The County Association control the recruiting arrangements for the Territorial Force, while the medical examination comes under the Administrative Medical Officers, Highland and Lowland Divisions. Medical inspection of recruits on the lines of that of the Regular and Special Reserve Force is obviously impracticable, but I avail myself of every opportunity of seeing the men in camp and on manœuvres. Speaking generally, the Scottish Territorial Recruits are of excellent physique and bore the hardships of the exceptionally trying manœuvres last year cheerfully and well.

The same system of instruction of medical examiners, with modifications, is carried out for Territorials as for Regulars. The combined staff tours and regimental exercises (R.A.M.C. and R.A.M.C.T.F.) afford me frequent opportunities of conferring with Territorial medical examiners, in addition to visits to the stations; and the manœuvres last year, during which I was Director of Medical Services, brought me into contact with practically every working (R.A.M.C.T.F.) officer in the Command.

Training of Recruits.

Training of Recruits in General.—As regards the general training of recruits at the depots, I venture to repeat my observations of last year, as they are exactly applicable to this.

"The training of recruits at the depots is carefully graduated and in no instance too hard. The vast majority of recruits improve remarkably in physique in every way under training. Apart from cases of organic disease, very few lose weight or "break down," and, generally speaking, those that do come under one or other of the two categories—(1) immature lads in the Special Reserve who are apparently, and probably really

under 17 years of age, and (2) cigarette-smokers, chiefly what may be called ante-prandial cigarette-smokers. There is a pernicious habit amongst many lads, who probably never smoked before they joined the Army, of smoking cheap cigarettes before breakfast, a habit very difficult to eradicate. I have satisfied myself that this is the direct cause of "disordered action of the heart" in its various manifestations of tachycardia, dropped beat, hæmic murmurs, &c., in the vast majority of cases; and that it is a frequent cause of syncopal attacks and weakness on parade. . . . As regards the other class of cases of 'breakdown' my experience is the same as my predecessor's, viz., that lads who are apparently under age lose weight and bear training badly."

Intemperance and Venereal Disease rare.—I am glad to note again that intemperance amongst recruits is rare; and that cases of venereal disease have been few.

Vaccination.—The reaction following vaccination, causing acutely inflamed arms and consequent loss of efficiency for varying periods, has been noticeably severe in two of the depots—Perth and Fort George. In Perth the loss of efficiency from this cause has been at times remarkable, especially early in the year. In Fort George within the last three months there have been several instances of "bad arms" in recruits, enlisted in the notorious anti-vaccinationist centre, Leicester, who have never been vaccinated before; such cases are, of course, quite easily accounted for.

Scabies at Depots.—At the Glasgow recruiting office a certain number of recruits suffering from scabies present themselves for enlistment, and the occasional appearance of one of these men still suffering from scabies at depots in other commands has led to correspondence and in one instance to a certain amount of friction. The very careful medical examiner at that office quite rightly accepts recruits suffering from slight scabies who are otherwise fit; I know from experience that in a large centre like Glasgow sending away a scabious recruit "to be cured" often means losing a recruit. After being passed he is treated carefully at the office, and in most cases cured; but the mere fact that he has to put on his civilian clothes again predicates a certain number of relapses, and to guard against this the depot or unit he joins is invariably notified *before* he joins. I accept entire personal responsibilty for this system; we cannot afford to lose good recruits, and I cannot see that the occasional appearance (three cases during the year) of a recruit with scabies at a depot constitutes a serious grievance; as a matter of fact, the ideal time to treat scabies is when the man can get into a complete change of kit afterwards.

Efforts to minimize Loss through Discharge.—We have now got our recruits. These lads of 17 and 18 have been enlisted and brought to the depot, where they are well fed, well clothed, well housed, and not overworked. The next problem is to *keep* them, that is, to prevent leakage

through discharge for medical unfitness on Army Forms E. 517 and B. 204, so far as this leakage is preventable. The chief causes of medical unfitness subsequent to enlistment in this Command are: (1) Heart troubles; (2) ear diseases; (3) dental caries; (4) hernia; (5) defects of lower extremities; (6) flat feet; (7) spinal curvature—permanent, or intermittent from disability or poor physique. These disabilities will be discussed in detail in the next section of the Report: here I deal with them only from the point of view of training, to show what can be done towards saving men for the Service by individual care and, above all, to emphasize the importance of physical training as a therapeutical agent.

(1) *Heart Troubles—Prevention.*—Cases of organic disease, overlooked by the medical examiners, must of course be discharged. But a large proportion, if not all, of the class of cases conveniently grouped under the heading "Disordered Action of the Heart" can be cured, given the will on the part of the recruit—an important reservation. I repeat again here an observation made before: "I have satisfied myself that this (*i.e.*, cigarette smoking, especially before breakfast) is in the vast majority of cases the direct cause of disordered action of the heart, in its various manifestations of tachycardia, dropped beat, hæmic murmurs, &c.; that it is a frequent cause of syncopal attacks and weakness on parade. . . ." Many, perhaps most, of the lads, joining the Special Reserve and even the Line learn to smoke at the depots for the excellent reason that they could not afford to smoke before; the tobacco smoked is in the form of cheap cigarettes, and for some inscrutable reason—probably because the practice is strictly forbidden—the fashionable hour for smoking is before breakfast. Those of us who are smokers will have a vivid recollection of the sickening "tumbling" action of the heart which accompanied the faintness and nausea engendered by our first efforts at smoking, and know that even confirmed smokers are apt to suffer from the same feeling if they smoke in the morning on an empty stomach. That in the case of lads of 17 and 18 serious heart trouble follows this practice when carried on day after day is not therefore surprising; one is rather surprised, in fact, that there is not more of this induced disability.

The remedies are obvious: advice and friendly warning to the lads by N.C.Os; frequent examination by medical officers; disciplinary measures. A considerable measure of success has attended our efforts in this Command, notably at Perth, where at one time last year (see my last Annual Report) disordered action of the heart due to ante-prandial cigarettes almost assumed the dimensions of an epidemic. I have to thank the officers commanding depots throughout the Command for their very hearty co-operation in working to stamp out this evil.

(2) *Ear Diseases.*—Ear disease is common amongst recruits in this Command, especially in Eastern Scotland. Much may obviously be done, and is done, by careful medical officers to prevent this by systematic periodical examination of throats and ears so as to get these lesions in

their first beginnings. Tonsillitis and naso-pharyngeal catarrhs prevail extensively in Aberdeen in the winter and spring, and unless arrested frequently end in middle-ear disease.

(3) *Dental Caries.*—The great prevalence of dental caries amongst Scottish recruits, especially Lowland recruits, is well known; and few indeed are the recruits joining the depots who do not present signs of dental caries to a greater or less extent.[1] Here again good work is done, not only in the direction of conservative dentistry before and after enlistment, but by careful routine examination of teeth and mouths, the employment of simple means of preventing oral sepsis, toothbrush drill and the provision of simple tooth-powders such as precipitated chalk. Grave doubts have recently been expressed by qualified observers as to the efficacy of the ordinary toothbrush, at all events of the same toothbrush, used again and again; but we must do the best we can with the means at our disposal, and in dealing with recruits, many of whom never brushed their teeth before joining, undoubtedly the use of the toothbrush is better than nothing, as the adoption of other means, such as the use of floss silk, antiseptic tooth picks, and expensive oral antiseptics, is obviously impracticable.

Consideration of the next groups of causes of discharge subsequent to enlistment is closely bound up with

The Therapeusis of Physical Training.

Physical Training.—Of the general value of physical training for recruits I am more and more convinced as my experience grows greater. I venture to repeat here the first two sentences of my report on the subject last year: "The modern system of Army physical training, founded on the Swedish system, working as it does towards the harmonious development of the *whole* body, is an immense improvement on the old one-sided 'gymnastics' system. I have been also particularly struck by the increased mental alertness which accompanies *pari passu* the physical improvement in recruits under the present system, and this impressed itself on me long before I read Baron Posse's valuable book ('Special Kinesiology')." Given capable and patient instructors, physical training is potent for good, impotent for evil.

But what I am more immediately concerned with now is not so much the general value of physical training for healthy recruits, or recruits free from physical defects, as with its importance as a valuable therapeutic agent in curing defects which would otherwise lead to inefficiency and discharge: this curative use is not, I think, sufficiently realized. Excellent work in this direction has been done in the Scottish Command during

[1] With the notable exception of the Islanders joining the Seaforth, Cameron, and Gordon Special Reserves.

the year with gratifying results in the shape of a considerable reduction in the number of discharges for unfitness after enlistment.

I take this opportunity of expressing my thanks to Captain Alexander, Superintendent of Gymnasia in the Command, for his cordial and enthusiastic co-operation in this work; he placed his staff unreservedly at my disposal, sent circulars on the subject to his instructors, and did everything in his power to help on this which may be called the medical part of his specialty. It will, of course, be clearly understood that the exercises prescribed for recruits with the following defects are *in addition* to the regular routine of physical training: men with flat feet, for example, continue doing the "heel-raising" exercise daily as additional work, while they leave this exercise behind and pass on through the various stages of progressive training during the official course. With rare exceptions, where the recruit is tired of the Army and does not wish to improve, we find no difficulty in inducing the lads to work at these additional exercises; in fact, men with slight defects which have been unnoticed often come forward and ask to join in the exercises.

(4) *Lax Abdominal Rings.*—A recruit with actual hernia is, of course, discharged unless he consents to an operation. But lax abdominal rings, which are very likely to lead to hernia if untreated (very common amongst miner recruits) can be rendered firmer and smaller by special "Abdominal Exercises" ("Manual of Physical Training," Group H, p. 121), though I am bound to admit that efforts in this direction have not been attended by any very conspicuous success.

(5) *Defects of Extremities.*—For convenience in picking out "flat feet" in recruiting tables all defects of lower extremities exclusive of flat feet are returned under this head. Stiff joints, more especially metatarso-phalangeal joints, not actually ankylosed, are very common here. Curative exercises for individual cases are easily devised and carried out, if not already noted and described in the Manual.

Cases of stiff joints in the upper extremity—old reduced dislocations of shoulder and elbow for instance—can also be usefully dealt with by exercises on the lines of the Zander Institute work.

The results of this treatment have been good: contrast the discharges for "Defects of Lower Extremities" in 1910 (5 Regulars, 20 Special Reserves) with this year's discharges (2 and 8).

(6) *Flat Feet.*—The treatment of flat feet by the "Heels-Raising and Quick-March" and "Heels-Raising and Knee-Bending" exercises (*vide* Manual) has been our most conspicuous success. If a lad of 17 or 18 can form an arch at all when in the "Heels-Raising" position there is every hope of permanent cure.

(7) *Spinal Curvatures.*—Here again the treatment of the various forms of spinal curvature, kyphosis, skoliosis (both common amongst miners) and lordosis, has had surprisingly good results, following careful and continuous practice of the "Span-Bending" and "Knees-Raising"

exercises: I look on the former as probably the most valuable exercise in the whole Manual.

Flat Chest.—There are other defects curable by regulated exercises, but this part of the report is already too lengthy and I can only mention the obvious and proved utility of breathing exercises ("Corrective Exercises") for flat-chested lads with poor expansion.

The voluntary system, introduced by Captain Alexander in several Depots, of wearing "running shorts" during the exercises is excellent, one of its advantages being that recruits wearing them are more inclined to bathe and rub down afterwards. I hope before long this system will be universally adopted in the Command; good "shorts," quite good enough for the purpose, can be made at as low a price as tenpence (Berwick-on-Tweed Depot).

* * * * *

I think I have said enough to indicate clearly the importance of the work a medical inspector can do, by individual care and curative physical training, with the great object of *keeping* recruits.

Pastimes.—Boxing I still believe to be the best of all pastimes for recruits, considered as supplemental to physical training. The Gordon Highlanders' Depôt at Aberdeen is *facile princeps* amongst the Depots in this respect.

Chief Causes of Rejection and Discharge.

The following tables show the chief causes of rejection by medical examiners of recruits (Table VII), and the chief causes of subsequent discharge on the recommendation of the medical inspector of recruits. I again draw attention to the fact that more than half of the Regular recruits discharged on Army Form B. 204, were discharged in other Commands: there was a large export of Scottish recruits this year direct to other Commands. The numbers of Regular and Special Reserve actually discharged on my own recommendation were 33 and 90 respectively.

TABLE VII.—Regular Recruits. Chief Causes of Rejection by Medical Examiners in Recruiting Year 1911. Total Rejections, 810.

Cause of rejection	Number of rejections	Percentage of total rejections
Loss and decay of teeth	169	20·8 per cent. (See Note.)
Disease of heart	66	8·1 ,,
Defective vision	77	9·5 ,,
Under standards[1]	64	7·9 ,,
Flat feet	35	4·3 ,,
Diseases of ears	40	4·9 ,,
Defects of lower extremities	24	2·9 ,,
Hernia	25	3·0 ,,
Varicocele	7	0·8 ,,

Note.—Compare rejections for teeth in Irish Command, 23·7 per cent.

[1] Of chest and height.

TABLE VIII.[1]—REGULARS AND SPECIAL RESERVES. CHIEF CAUSES OF DISCHARGE ON ARMY FORMS B. 204 AND E. 517 IN RECRUITING YEAR 1911.

Cause of discharge	Regulars	Special Reserves	Total
Disease of heart	13	9	22
,, ears	8	7	15
Loss and decay of teeth	5	6	11
Under standards[2]	1	10	11
Hernia	5	6	11
Defective vision	5	4	9
Defects of lower extremities	2	7	9
Epilepsy	3	5	8
Debility	1	7	8
Flat feet	5	2	7
Defective intelligence	5	2	7
Varicocele	1	4	5
Incontinence of urine	2	3	5
Stammering	2	3	5
Varix	2	2	4
Renal disease	1	1	2
Malformation of spine	0	2	2

Smaller numbers than four are not given in this list, with the exception of (1) renal disease, the object in this case being to contrast the figures for last recruiting year (7, all but 1 in Aberdeen) with those for this year (2, only 1 in this Command): and (2) malformation of spine, for which there were 9 discharges last year, only 2 this—an index of the work done by specialized physical training in the cure of this disability.

I now propose discussing in detail the more important of these causes of rejection and discharge together. As the report of a medical inspector of recruits is intended for the perusal of lay as well as professional readers, I shall avoid the use of technical medical expressions as far as possible.

Loss and Decay of Teeth.—The teeth of the class from which Scottish[3] recruits are mainly drawn are singularly bad: almost incredibly so to one who, like the writer, had worked previously amongst London recruits, whose dental standard is curiously and inexplicably high. There is no official standard for teeth: the only instructions given to medical examiners are, that a recruit should have a sufficient number of sound (which includes efficiently stopped) teeth to ensure efficient mastication, with the important reservations that the general nutrition of the recruit and average circumstances of European warfare are to be taken into consideration. I may add that the unofficial standard, or rather guide, formerly sent out to medical examiners of recruits was in this Command

[1] Includes Scottish Recruits discharged in other Commands: Regulars only.

[2] Of chest and height.

[3] And Irish, apparently—*cf.*, Rejections in Ireland, 23·7 per cent, with Scotland 20·8 per cent.

intended only for use in cases which are on the "borderland" in other respects.

The improved recruiting work is shown by the marked diminution in the number of discharges due to this cause this year.

Excellent work in conservative dentistry has been done at the recruiting stations, notably Edinburgh.

Diseases of Heart.—This heading accounts for much the same percentage of subsequent discharges as last year: of the 13 discharges of Regulars from this cause, 5 were discharged in other Commands. The ill-effects of the cigarette habit have been already discussed (*vide supra*). As more prolonged experience only adds fresh confirmation to my views on this subject, I venture to quote some of the observations I made in last year's report.

"A surprisingly large number of weakly lads are found to have heart-murmurs at one period or another during training; but I think it is a safe general rule to discount the importance of this sign if (*a*) there is no increase in the area of dulness; and (*b*) the apex-beat is not displaced. I have even seen cases of a fair amount of dilatation, combined with marked murmur, subside, leaving the heart apparently sound; and I believe I am correct in saying that modern heart specialists are more and more inclined to doubt the existence of organic heart disease in youths of the recruit age unless there is a previous history of rheumatism or acute infectious disease" (*vide* interesting article by Dr. Goodhart, *Lancet*, December 3, 1910). I have a vivid recollection of the homely advice given me twenty years ago by an old friend and distinguished member of our profession,[1] when I first sat as member of the Medical Board at the India Office under his presidency. "You will hear many heart murmurs in this room: take them always with a grain of the salt of common sense."

Young medical officers, fresh from big hospitals where the only heart murmurs they heard were organic, are far too apt to label "V.D.H." cases of hæmic murmur in weakly cigarette-smoking recruits.

Defective Vision.—Here again there is a marked improvement in the work of medical examiners—a result, partly at all events I hope, of the severe strictures I felt compelled to make last year on instances of carelessness in vision testing.

Last year I discussed at considerable length the vexed question of left-shoulder shooting in connexion with recruits' vision, and need not repeat remarks which I see no reason to modify. The experiment is being made, for the twelve months ending January 31, 1912, of insisting, in cases where one eye has normal vision and the other one-sixth normal ($\frac{6}{6}$ and $\frac{6}{36}$), that the *right* eye must be the normal one. The experiment is a very interesting one; but the value of the results

[1] The late Sir Joseph Fayrer.

obtained will be very much discounted by the fact that for a long time prior to the commencement of the experiment medical examiners, at all events in this command, had been guided in their vision-testing by a circular discouraging the enlistment of left-shoulder-shooting recruits; in other words, for all practical purposes, they carried out the present experimental test.

Recruits whose vision compels them to shoot from the left shoulder, and who, *ipso facto*, can only in rare instances become "quick-firers," will always be in a very small minority; but even that small minority is not insignificant in dealing with large numbers of recruits; and I must confess I do not like the possible prospect of losing them. A Swiss army medical officer, in a very able critical review of the vision tests of the Swiss army,[1] makes the following significant remark, "For some years men were enlisted with good vision in the left eye only; but this stopped *at the request of the instructors of musketry* (the italics are mine); I think this a pity, as many men are able to shoot well from the left shoulder, but are not at present accepted for the infantry." I believe I am correct in saying that military experts are not in entire agreement that all recruits must necessarily be potential quick-firers. I quite admit that, if this is necessary, it follows that the present experimental test must be made a permanent one.

I think now that medical examiners may be assumed to be perfectly familiar with vision testing by test-types, the question of relaxing the standard of vision in favour of departmental corps and men engaged in technical work is eminently worthy of consideration.

I have unconsciously written more on this subject, one in which I am deeply interested, than I intended; but it is difficult to over-estimate the importance of vision in modern warfare, and it is equally difficult to over-estimate the importance of any change likely to increase or diminish, even in a small degree, the number of recruits. As I know from experience in initiating the change from the old "dot" vision test to the present type test, even slight alterations in tests for recruits mean, perhaps, considerable alterations in recruiting. The recruiting machine is one of very delicate equilibrium, especially where vision tests are concerned; the substitution of the type for the "dot" test affected this equilibrium favourably; tampering with the type test may possibly have the opposite effect.

Diseases of Ears.—Discharges from this cause show a big reduction, partly due to improved recruiting, partly to increased care at the depots. In the spring and early summer of 1910 there was a curious unexplained prevalence of ear trouble amongst recruits at Aberdeen—a city, however, rather notorious for naso-pharyngeal catarrhs and other contributory causes of otitis media.

Under Standards.—The discharges have fallen from nearly forty in

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[1] *Revue Militaire Suisse*, March and April, 1910.

the recruiting year 1910, to eleven (only one Regular) in this year. This great reduction is a sure index of improved recruiting. In this connexion I must confess my personal liking for the German method of expressing the chest measurement figure; expansion is largely a knack which can be taught by an instructor in physical training, and even by an astute recruiter. In this Command we adopt a local standard of weight: minimum 105 lb. for the Special Reserve and 112 lb. for Regulars. The medical examiner's discretion in accepting lower weights in exceptional cases is not fettered; but instances of recruits accepted with weights under these have to be reported at once to the medical inspector, so that the men can be specially watched at the depots. I have alluded before to "Special" enlistments for heights.

Flat Feet, Malformation of Spine, Defects of Extremities.—The great reduction in discharges from these causes is most gratifying. There were only two Special Reserves and five Regulars discharged for flat feet during the year, and three of the latter were artillery recruits joining the Western Command, who were discharged there. Personally I am not prepared to admit that flat feet in an artillery driver is any very serious drawback.

Hernia.—Efforts to improve "lax-ring" cases and lessen hernia have not been very successful.

Varicocele.—Discharges are few. I am sure the ill-effects attributed to varicocele are exaggerated, but I need not repeat views expressed at length last year.

Epilepsy, Defective Intelligence.—Obviously recruits with either disability must be got rid of; but in the case of defective intelligence I insist on written evidence from medical officer, adjutant, and instructor, accompanying application for discharge.

Stammering.—Cases of impediment of speech, even of moderate degree, do not do well at depots, and are apt to infect others with a tendency to stammer.

Scottish Recruits discharged on Army Form B. 204 *in other Commands.*—11, Western; 9, Northern; 7, Aldershot; 7, Irish; 3, Eastern; 3, London—40 in all.

I have endeavoured to show that, given a just and unwavering policy on the part of principal medical officer and medical inspector in a command—an all-important qualification—a reduced rejection rate and a reduced discharge rate may not only be compatible with, but an index of, increased efficiency. Subjects not purely medical, such as paucity of recruits from particular areas, general causes of shortage, &c., have been touched on here and there; but there is a borderland in recruiting work in which military and medical considerations are inextricably mingled, and a medical inspector of recruits, if I interpret his duties aright, has to endeavour to be not only a capable medical officer, but, according to his lights and in his own sphere, a medical statesman.

SANITARY REPORT OF MANŒUVRES, BURMA DIVISION, 1912.

By Major R. TILBURY BROWN.
Royal Army Medical Corps.

In this report I wish to draw special attention, in the first place, to the increased interest which has been displayed by combatant officers generally in the subject of sanitation and to the improvement consequent thereon. This was evidenced by a camp being in occupation for three weeks without the appearance of flies.

In the second place, to the good work and utility of that new unit—the Sanitary Section.

From a sanitarian's point of view the manœuvres consisted of two distinct phases, viz., the march to the standing camp and the standing camp itself. This report is, therefore, divided into two portions, viz., *The March* and *The Camp*.

The March.

The main column marched from Mandalay to Nawngpeng, preceded by an advance column from Maymyo.

The Mountain Battery marched from Bhamo to Nawngpeng.

Regimental Sanitary Detachments.

When on the march the sanitation of units was performed by the Regimental Sanitary Detachments (R.S.D.) These were well trained and organized with the exception of those in small units, such as Mounted Infantry, but there are a few points which require attention.

(1) *Organization.*—In infantry regiments the full complement of one N.C.O. and eight men is always employed, and in some cases this number is augmented by the men trained in sanitation (*vide* A.R.I., vol. ii, para. 893).

In smaller units, such as artillery, mounted infantry and sappers and miners, there is some doubt as to the number to be *employed* though there is none whatever as to the number who must be *trained*. A.R.I., vol. ii, para. 893, lays down that 2 N.C.Os. and 2 men per battery and company R.A., or per company sappers and miners, are to be trained in sanitation.

I.A.O. 708—10 lays down that 1 N.C.O. and 1 man per unit are to be employed in the R.S.D., but A.R.I., vol. ii, para. 893, omits the N.C.O. and employs only 1 man per unit. As N.C.Os. must be trained, and so recent an order as 708—10 lays down that one must be employed, and as it is necessary to employ one in order to obtain efficient sanitation, it is desirable that these units should have regimental sanitary detachments composed of 1 N.C.O. and 1 man per unit. The unit consists of a battery or company of R.A., a company of mounted infantry and a company of sappers and miners.

(2) *Employment.*—In infantry regiments the R.S.D. should work more as an independent unit of the regiment. After a rest camp or bivouac has been cleared the R.S.D. should resume the march in a body with the first line of transport. Before going into a rest camp or bivouac the C.O. or quartermaster should see that the R.S.D. are among the first on the ground so that they can commence work without delay.

In smaller units it may not be possible to work as above, but care should be taken that the R.S.D. get together and to work as soon as possible on arrival at the camp.

In rest camps on the line of march it often happens that too much of the executive work is laid on the sweepers. It is among the duties of the R.S.D. to dig latrines and urinaries, to make incinerators, &c. It is the duty of the sweepers to keep latrines clean, apply fresh earth, keep up the fire, &c.

On arrival at a post, units supply the post commandant (or Rest Camp officer) with 2 police per 100 men and followers (*Mob. Regs.* Ind., para. 176). These police should not be taken from the R.S.D., although their duties may include guarding the water supplies, &c. The R.S.D. are for work only in the area which the unit occupies.

Sanitation on the March.

When small bodies of men are out in the jungle; when they are on the move and no other troops are following them, it may be immaterial if no provisions are made to prevent fouling of the line of march. But when other troops are following them the matter is very different. Fouling the line of march may originate disease, by flies and infected dust, amongst all the units who are following. If we do not practise some efficient solution of the problem during peace and when on manœuvres, we shall certainly fail when on active service.

The following solution is suggested. I have seen it carried out with British troops with success, and I see no reason why some such method cannot be employed by Indian troops. Any reports on trials or suggestions will be welcomed. It is found, after a short time, units so quickly clear their camp or bivouac that the sweepers are ready to march with their units. Let one sweeper march close behind each company (or double company) and carry a spade, or have one handy. At a halt send a sweeper out to a flank to turn up the ground in two or several places as he finds necessary. On resuming the march the turned-up soil is replaced. Every regiment has several trained men (18) in addition to its R.S.D. (A.R.I., vol. ii., para. 893). Every company should have one or more trained men. When the company (or double company) halts one of the above men should fall out to supervise the sweeper. When a man falls out to defæcate he should go to the place where the sweeper is at work. This spot could be more clearly defined by a yellow flag on a post also carried by the sweeper. The earth should be turned up

in places about 3 ft. apart, in line and behind a bush. It is not necessary to dig regular trenches, though with practice it is extraordinary how quickly a man can dig a proper trench of 4 or 5 in. deep.

Sanitation in Bivouac.

On the whole the sanitation of bivouacs was very well done. Shallow trenches were used and well supervised, manure and refuse were burnt, water was policed and bivouacs were well cleared up.

The systematic working of the R.S.D. is referred to later; its importance is seen in bivouacs, which are often not entered till late in the day and after a hard fight or march. Unless the detachment works in a systematic manner, sanitation will suffer owing to the length of time taken to complete the arrangements. If the site is known, the R.S.D. can often be there and have their work finished by the time the regiment arrives.

Regimental Sanitary Detachments should have flags, and especially yellow ones, as a part of their equipment, and should use them at bivouacs.

Rubbish should always be burnt. A horse-shoe shaped incinerator is excellent for ordinary camp rubbish, and is very quickly made. Care should be taken to dig out the earth for making the incinerator from one place, thus leaving a pit into which, when the bivouac is vacated, the contents of the incinerator can be thrown and then covered over with the earth of which the incinerator is made.

In dry weather, when dealing with large quantities of manure (supply column, mounted infantry, &c.), it is better to get a fire well alight with dry refuse, then heap it over with all the manure rather than try to burn it in small quantities. In the former case, the fire will generally keep alight until the whole is burnt. In the latter case the dry litter burns quickly away and leaves the manure practically unscorched.

Sanitary Section.

Normally, upon the line of march and at bivouacs, the sanitary section is fully occupied in the sanitation of its own area. It has nothing to do with the sanitation of other areas, but leaves squads behind to sanitate posts as they are opened up.

The section, however, is specially trained in the preparation and protection of water-supplies, and this can often be taken advantage of, as was done on several occasions. For example, when on the march with the advance party they prepared several drinking supplies for the main column. Again, when in standing camp, they went out, prepared and policed the drinking-water supplies at two bivouacs.

The section marched with the advance party and assisted it in repairing roads. The O.C. section made route reports for information of the S.M.O. of the main column and the A.M.O. These may be of

great service on future occasions and give information as to condition of road, cultivation, stores and milk procurable, water available, size of village, diseases in village, &c.

On arrival at a bivouac the section prepared its area. The O.C. section selected the nearest available site for the main column, made a plan showing the arrangements for water and any particular point, such as general sites for latrines, prevalence of disease in the village, &c., and forwarded it to the O.C. main column. The section put up flags and prepared water supplies when necessary; for instance, they made a drawing platform at one place, dammed a stream at another, opened a spring at a third, &c.

The N.C.Os. were trained to write down the sanitary arrangements they would make in the event of their being left behind to open a sanitary post. The N.C.Os. of Indian regiments were soon able to do this and write notes in an intelligent manner. They should be trained as above more frequently by the M.Os. of regiments. The British N.C.Os. were very good at this work.

The Camp.

The camp was at Nawngpeng. It was situated on slightly sloping ground at the base of a hill and about half a mile from Nawngpeng Railway Station. It was treated as a standing camp on the lines of communication.

Water-Supply.

(*a*) *Drinking Water*.—Water was limited in amount. The following account of the method of conserving it is rather full, as it well illustrates one of the methods capable of adoption in these difficult circumstances.

Fig. 1 represents the water-supply as it existed before the arrival of troops.

AB is a small surface drain collecting small quantities of spring water from the marsh to the north and a fairly large supply at F from springs situated at C. The water discharged at E through a bamboo spout into a small *nullah* 2 ft. below.

XX is the top of the watershed. All water east of XX drained away towards D which was a large stream of polluted water flowing south.

G, H and J were small springs flowing east.

At E the water had discharged at the rate of 600 gallons per hour, but had decreased to nearly 500 gallons per hour in the preceding fortnight. The water was extremely good, both chemically and bacteriologically, cold and palatable. It could easily be protected from any possible pollution.

It was estimated that 3,000 gallons would give one day's supply at 1 gallon per head.

Fig. 2 represents the arrangements for collection and methods of protection.

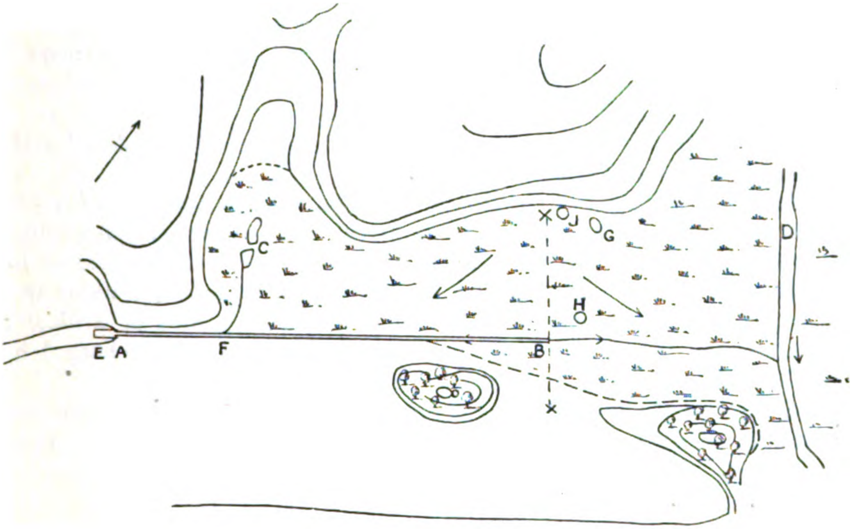
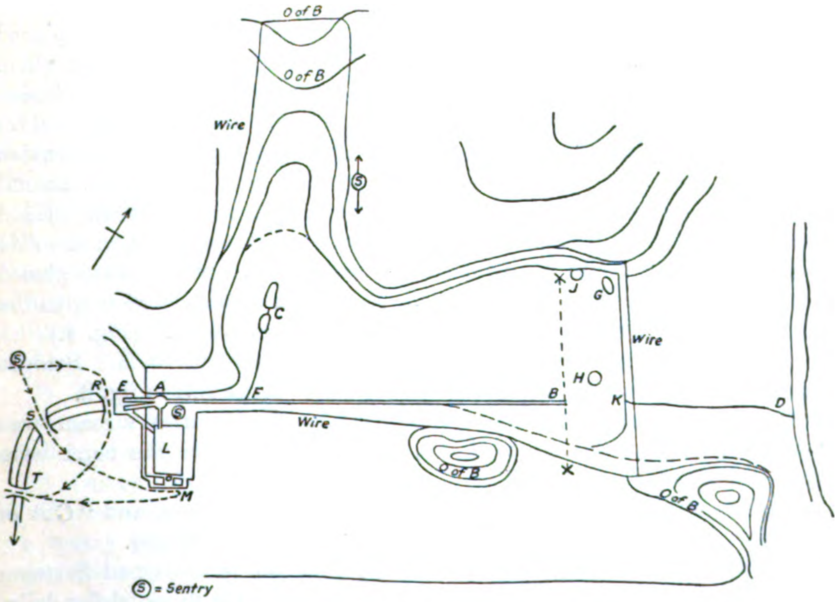

C
J
G
D
H
E
A
F
B

Fig. 1.


O of B
O of B
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O of B
O of B
S = Sentry

Fig. 2.

A dam was thrown across the marsh at K to the east of the watershed XX. The springs at J and G were opened up. In this way all the water between B and K filled up this area till it rose to the level of the water west of B and then flowed west instead of running to waste in an easterly direction. The dam was made of sods and puddled with clay on its west side.

The springs at C were cleared, and the channels CF and AB were cleared, graded and slightly deepened.

A small pit reservoir was made at A and from it there ran (1) two bamboos (E) which took the natural discharge of water, and (2) an iron pipe which was 4 in. lower than the bamboo outlets and was closed by a movable wooden plug in the pit. By these means (*a*) water was normally discharged from two spouts for the convenience of a *bhisti;* (*b*) when the plug in the iron pipe was removed, water discharged by means of the pipe without having to plug the bamboos.

A reservoir holding 3,000 gallons was constructed at L. This was made by digging a pit with sloping sides and lining it with large tarpaulins. The tarpaulins were sewn together by a double row of stitches. (Fig. 3.)

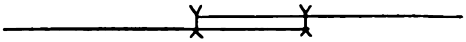

FIG. 3.

Two iron tanks, each capable of holding 800 gallons, were placed on trestles at M. A rotary pump was fixed on a stage between them and the reservoir. These tanks were sent to camp and painted inside and out with red lead paint which was wet and partially detached in places in large flakes; this was cleaned off by a Brahmin lance-naick of the Sanitary Section by rubbing with wood ashes. The tanks should have been fitted with two taps each instead of one, the taps being placed either on opposite sides of a corner, or at such a distance apart on one side that two *pakhals* could be filled at the same time. Stones were placed in a drainage trench under the taps. The drain communicated with the overflow drain from the reservoirs and ran into the stream. (Fig. 4.)

A wooden staging was made under the bamboo spouts at E. Bridges were built at R S and T, and traffic was directed as shown in fig. 2.

Fences were made between the bridges. The outlet stream was cleared, its edges cut, hollows filled, and any pools near the bank were filled or drained.

A barbed wire fence was placed round the whole area, and "Out of Bounds" notices were erected, stencilled in three languages.

By the above arrangements, the supply of water remained between 550 and 650 gallons per hour, although the supply was diminishing daily.

If further difficulty had been experienced, a well would have been

sunk near D, a rotary pump erected, and water pumped along a bamboo channel into the channel A B.

When but little water was being drawn (generally between 12 noon. and 2 p.m.) the plug in the iron pipe to the reservoir was taken out and the reservoir allowed to fill, and overflow if necessary. All *bhistis* had to use the tanks, and the tanks were kept filled by a man at the pump. At night the plug was again removed and the tanks filled. In the morning the plug was reinserted. In this way there was every morning a reserve of 4,600 gallons in the reservoir and tanks, and a running supply of about 600 gallons per hour.

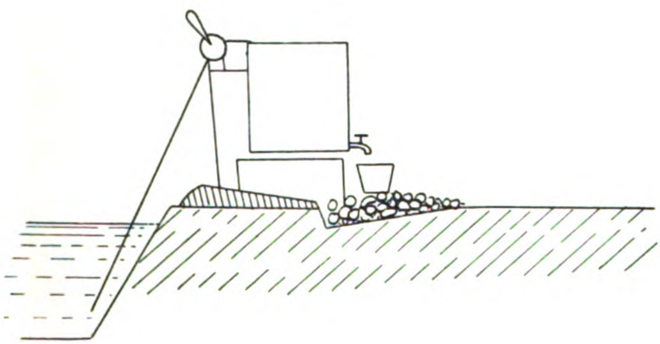

FIG. 4.

During the day, and especially in the morning and evening, there were "rushes" on the supply. At these times *bhistis* used the running water at E and the tanks, and the tanks were kept filled from the reservoir by a pumping party. At ordinary times the tanks were not allowed to be used.

The supervision of traffic, the plugging of the pipe, the supervision of the pumping party and the work at the tanks was done by a Brahmin of the Sanitary Section who was permanently on duty. The direction of traffic, pumping and policing of the area was done by men of the Sanitary Section, assisted, as far as the traffic was concerned, by Military Police.

(*b*) *Bath Water.*—Fig. 5, B. Bath water was drawn by *bhistis* from a well of good water, but which was liable to pollution. The possible pollution, however, was remote.

(*c*) *Animal Drinking Water.*—Fig. 5. At C^{i} a surface drain was led off from a stream. At C^{ii} troughs were made on the bank and filled by a rotary pump.

(*d*) *Bathing.*—Fig. 5. At D^{i} a bathing pool was made to take the overflow from C′. At D^{ii}, D^{iii}, and D^{iv} bathing pools were made along a stream.

Directing sign boards were erected in numerous places, and were stencilled in three languages, English, Urdu, and Nagri.

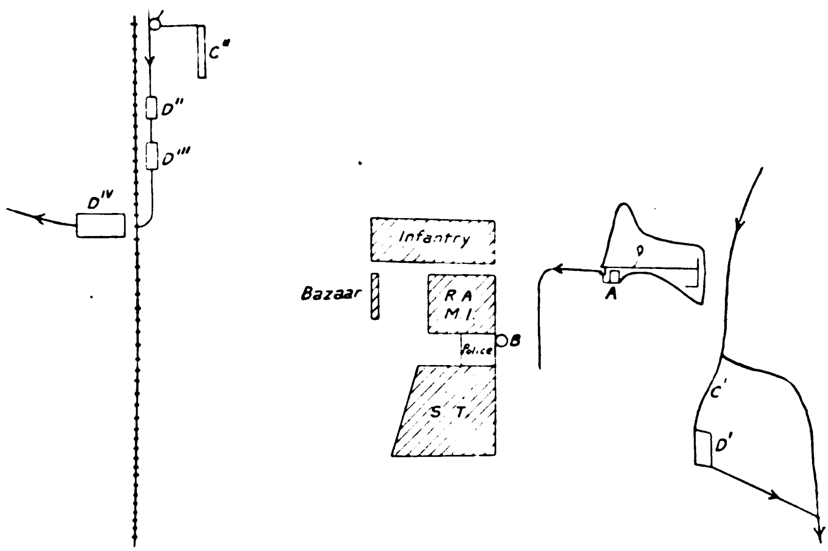

FIG. 5.

BAZAAR.

A camp bazaar was made. Stalls were allowed to be built only according to a standard pattern. A sweeper was employed by the stall holders. All holders were registered and wore badges.

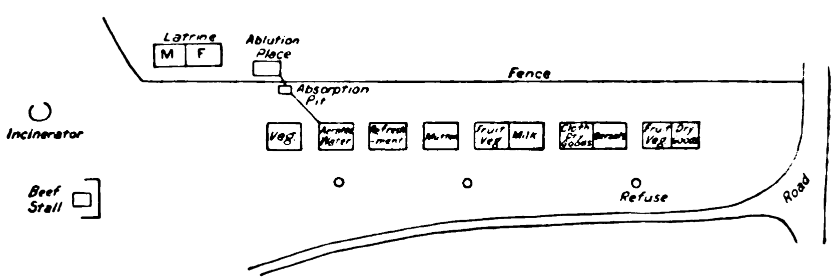

FIG. 6.

The stalls were made of bamboo and thatch, the floors were 1½ ft. off the ground, they were erected in one line with the beef stall and the incinerator on a flank, refuse receptacles in front, and a latrine and ablution place behind.

Slaughtering places were defined, and a slaughter trench was dug daily. Cattle pens were allocated a short distance from the bazaar. Bazaar rates were fixed and did not exceed the local bazaar rates. The sanitation of the bazaar was supervized by the Sanitary Section. Aerated waters were manufactured in the bazaar from the camp drinking water-supply. Milk was inspected daily and boiled before sale; a special stall was kept for this.

Railway Station.

The station was used by fatigue parties in loading and unloading trucks. A latrine was made, and a drinking-water well was selected near by. The above places were marked by flags, and directing posts, in three languages, were erected. The station was visited daily by a fatigue party of the Sanitary Section.

Cook-houses.

(*A*) *Men.*—Fig. 7, shows the arrangement of a Gurkha battalion, that is to say a regiment of one caste.

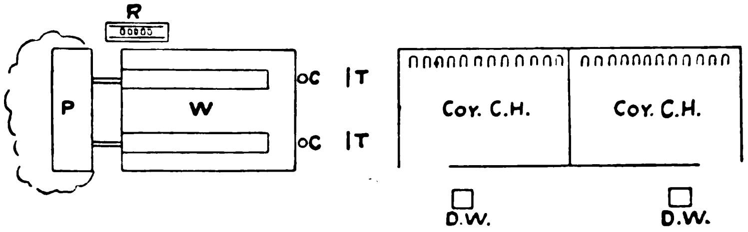

Fig. 7.

Coy. C. H. = Company cook-house.
D. W. = Drinking-water stand.
T. = Trestle.
W. = Washing-up place.
C. = Charcoal (wood ashes).
R. = Refuse.
P. = Pit (absorption).

The Company cook-house consisted of a smoothed and levelled piece of ground surrounded by a grass or brushwood screen.

The drinking-water stand consisted of a raised table on which a *pakhal* was placed. It was covered with a grass thatch, and had a pit *refilled* with loosened earth beneath.

The washing-up place is described in detail as it was found very effective and free from flies.

A rectangular piece of ground was levelled, smoothed and rammed hard. Two triangular trenches were dug across the levelled ground,

sloping slightly in the direction of the pit and joining the pit by means of narrow channels.

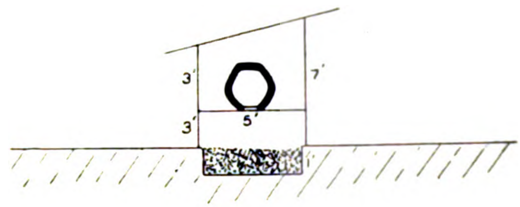

FIG. 8.

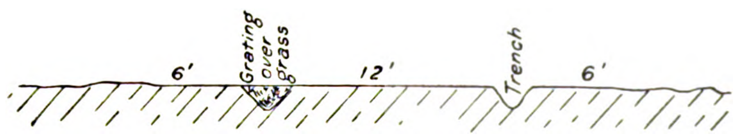

FIG. 9.

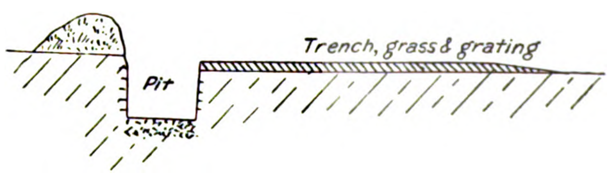

FIG. 10.

A pit was dug about 2 ft. away from the above piece of ground. It was 2 ft. deep, the same length as the washing place and 3 ft. to 6 ft. wide. The earth at the bottom of the pit was picked loose to a depth of about 1 ft., and holes were picked in the sides of the pit in numerous places.

Grass was placed in the trenches and covered by a grating. The grating was made of flat strips of bamboo, tied at each end to long bamboos the length of the trench. The grating was the same width or a trifle narrower than the trench so that when it was in position it rested on the grass and the sides of the trench; if it is wider than the trench, fouling of the ground takes place.

A trestle was made near each trench to support the grating and dry it after it had been washed.

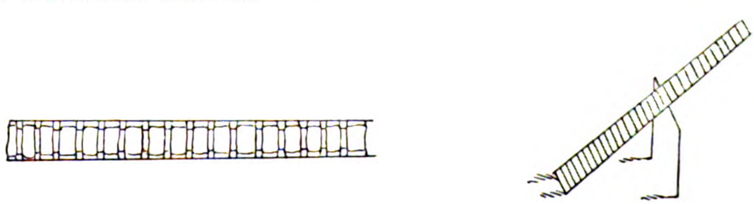

FIG. 11.

A small hole was made near each trench, and kept filled with wood ashes by the company cooks.

A refuse carrier was made of two bamboos 6 ft. long, with a closely plaited network of bamboo strips in between. The carrier was placed on two low trestles which supported the handles. The ground beneath was levelled, smoothed, and then sloped so as to drain into the pit.

The routine working of the washing-up place is highly important and must be strictly adhered to.

As soon as washing-up was finished the grating was removed and the fouled grass was put in the refuse carrier. Dry grass was put into the trench, and into the drain to the pit and over the soiled ground on either side of the trench. The dry grass was then burnt. The grating was washed and scrubbed (over the pit on both sides), it was then stood on end to dry against the trestle. The burnt grass and debris were swept into

Fig. 12.

the pit. The refuse carrier was taken to the incinerator and its contents burnt. The ground beneath the refuse carrier was covered with dry grass, which was burnt and swept into the pit. The carrier was washed and placed in position on its trestles and covered with grass. Care was taken to see that the trench, drain and surrounding ground were smooth, *perfectly dry* and clean, and a little loose earth was scattered over these places. Loose earth was put into the pit until it was dry. Sufficient dry grass was placed close to but not inside the trench. The wood-ash hole was seen to contain ash.

On requiring to use the washing place, the loose earth was swept into the pit; the dry grass was placed in the trench; the grating was placed over the grass and trench. Men squatted on either side of the trench and washed up on the grating. The fouled water strained through the grass and pieces of food were caught up. Water drained away into the absorption pit.

The above procedure is quite simple in practice. It must be carrried out each time that a trench is used, which is generally twice a day.

Fig. 13 shows one of the cook-houses used by a Punjabi regiment. There were four cook-houses—one for Sikhs, one for Dogras, and two for Mohammedans.

D.W. = Drinking-water stand.

W. = Washing-up place.

C. = Cooking place.
B. = Baking place.
D. = Boiling place.
T. = Trench for washing hands and mouth.
E. = Wood.
R. = Refuse.

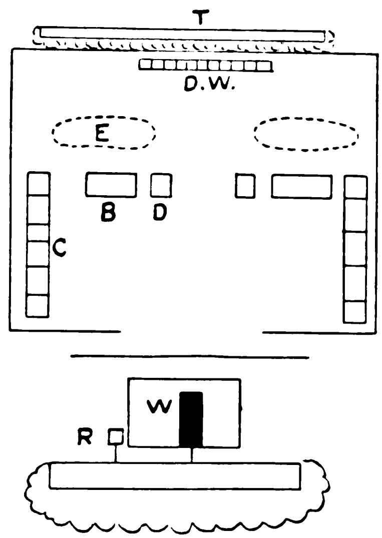

FIG. 13.

(*b*) *Officers' Mess.*—These cook-houses and washing-up places are, as a rule, badly made to start with, being left to the devices of the contractor instead of being made according to a specified plan. They are generally badly supervised, owing to a prevailing idea that the R.S.D. has no right to interfere, whereas the N.C.O. in charge of the R.S.D. should be held responsible for the cleanliness of these places as well as for every portion of the area in which the unit is encamped. They are usually the worst places for flies, owing to the above reasons, and to the pieces of foodstuff to be found in and behind boxes and other receptacles in the cook-house, and to the general want of cleanliness.

It is essential that there should be :—

(1) A washing-up and drying bench.
(2) A washing-up grating.
(3) An absorption pit.
(4) Refuse receptacles.

The washing-up and drying bench must be large enough for the mess men to work at, off the ground with nothing beneath, and drained into the pit. It must be washed, above and below, daily.

It is found that cups, saucers and other light articles are washed on this bench, but that it is absolutely necessary to have a washing-up grating for cleaning the pots, &c.

Washing-up Grating.—A convenient form is that described for the men and placed over the drain leading to the absorption pit. The portion of the drain which is covered with the grating must be filled with fresh grass twice a day.

Refuse Receptacles.—As a rule, two receptacles are required. They may be empty tins, or baskets half filled with grass. They must stand off the ground.

Fig. 14 shows an arrangement which works well, though many modifications will do equally well if the above essentials are complied with.

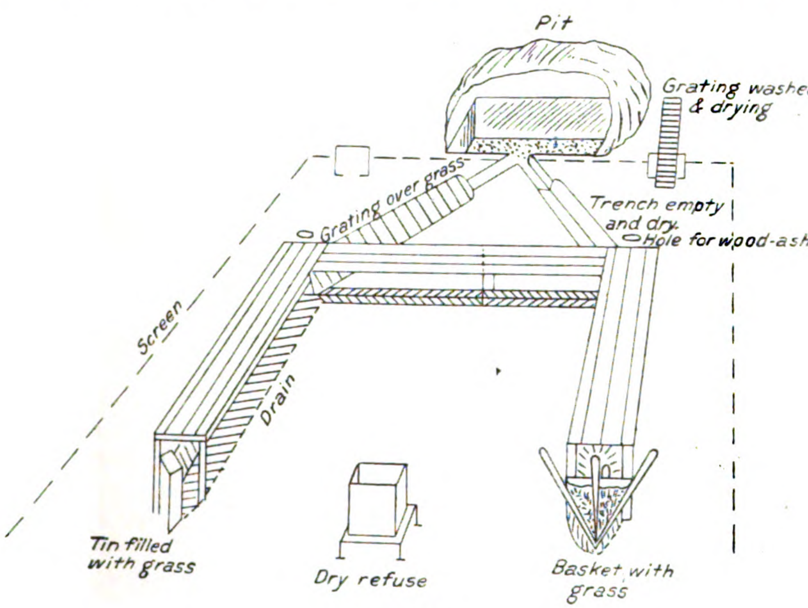

FIG. 14.

ABLUTION PLACE FOR NATIVE OFFICERS.

Fig. 15 shows an arrangement which was found satisfactory.

LATRINES.

Latrines were on the "shallow trench" system. They were 3 ft. long, 9 in. wide, and not less than 1 ft. deep.

Note.—Nine inches wide is more convenient for Indians than the usual 1 foot.

The latrines were very satisfactory with the exception of those in a small unit, which did not have a R.S.D. when it first arrived, in which

trenches were not properly dug and the ground was badly fouled. It was a striking proof of the absolute necessity not only for the employment of a R.S.D. (Regimental Sanitary Detachment) in small units, but also for the training of these men during "peace" time.

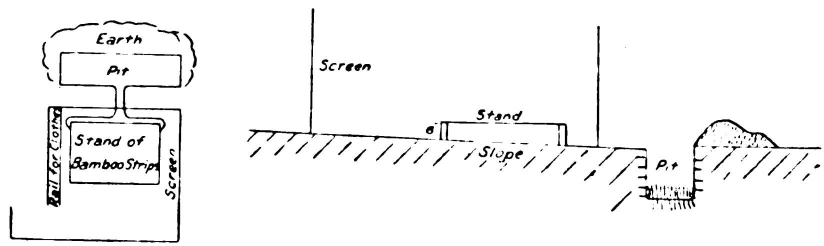

FIG. 15.

Position of Latrines.—The latrines were placed in rear of the camps, but as the slope of the ground was towards the camp, a shallow surface drain was cut below the latrines so as to divert any surface water into the main drains which ran down the roads between the units.

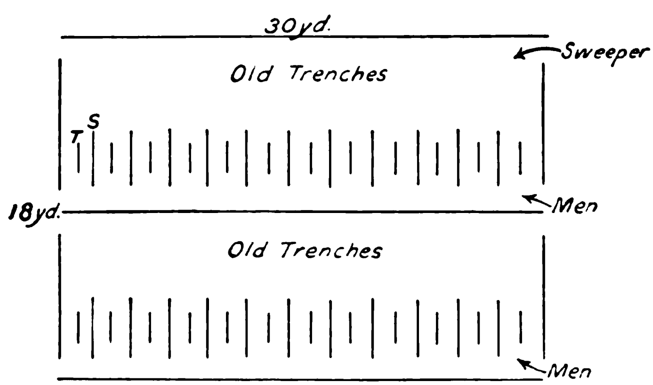

FIG. 16.—*S* = Screen. *T* = Trench.

It is a debatable question as to how far the latrines should be in rear of a camp. If ground is unlimited, one is inclined to place them very far back, but for training purposes I consider that shallow trenches should not be too far, because: (1) They are not so easily supervised; (2) on service they will frequently have to be close; and (3) if properly looked after they should neither be a nuisance nor a danger to health. One regiment had them 180 yds. in rear of the camp, which is too far. Another regiment had them 50 yds. in rear and found them quite satisfactory. It is true that the first regiment had its cook-houses in rear of

camp, whereas the second did not, and this raises the question of the position of the cook-houses, which is noticed under "laying out a camp."

Area of Ground Used.—The unit which worked its trenches the best was in camp for twenty-four days and used a piece of ground 30 × 18 yds. There were about 500 men and followers, besides N.C.Os., and twenty-four trenches in all were dug daily.

Fig. 16 shows the latrine at the end of twenty-four days.

One regiment of 650 men and followers had thirty trenches and used a piece of ground 40 × 32 yds. This was a needlessly large area, due to insufficient accuracy in making the trenches.

Latrine Screens.—The most convenient screens were found to be those made of grass, caught up between strips of bamboo. They are easily moved and last a long time.

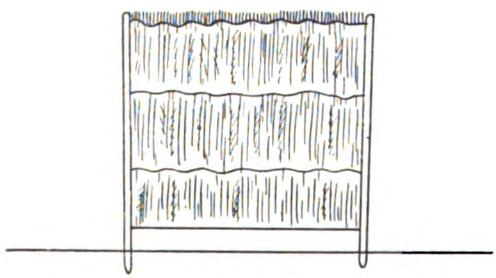

FIG. 17.

As an instance of how quickly these trenches can be dug: At the R.A. latrine and urinal, one sweeper was permanently employed and had no other duties. Every morning he closed the old trenches and dug fresh ones. There were ten trenches, and he finished this part of his work in two hours. In large units the old trenches should be filled by the sweepers, and the new trenches dug by the R.S.D.

Officers' Latrines.—Fig. 18 shows a latrine used by twelve officers for twenty-four days; it is easily enlarged, if required, by advancing the front screens. When seats are used, the excavated earth should be placed in front and to one side, but not behind. A cut large bamboo makes a convenient scoop. When commodes are used, a trench should be dug daily in a compartment next to the latrine, into which the sweeper places the contents and washings of the commodes.

Fig. 19 shows a comfortable and quickly made seat. The four uprights are of wood and the small pieces are bamboo. The width inside should not be less than 2 ft. The height in front should not exceed 20 in., and the height behind should be 24 in. Nails should be used in making the seat, as bamboo strips soon loosen. The thigh supports

must be smooth and placed at an angle of about 60° from the centre of the front rail. The legs should be joined all round, by cross pieces in order to strengthen them; they are omitted from the figure for the sake of clearness.

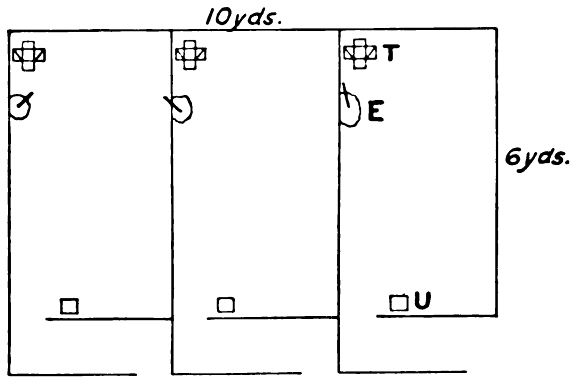

FIG. 18.—*T* = First trench. *E* = Earth and scoop. *U* = Kerosine oil tin urinal on stand

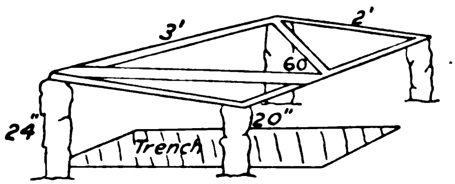

FIG. 19.—Latrine Seat.

URINALS.

Urinals were on the urine trench and absorption pit principle.

When absorption pits have to be made on the slope of a hill it is better to make a long narrow pit rather than the usual square one. The pit should lie across the direction of the slope. By this means absorption is greater.

For a single urinal, the usual double trench is sufficient (fig. 20).

For a multiple urinal, three trenches running into a long narrow pit make a good one (fig. 21).

The dotted line indicates the position of the next trench, which must be dug as soon as the first one becomes foul. When the squatting position is used, the trench should not exceed 9 in. in width, and men should squat across it. When the upright position is assumed the trench should not be less than 2 ft. in width and men should stand alongside.

The main point in these urinals is to keep the ground dry, in which case the trenches often last four to five days. After troops leave camp in the morning, the sweeper should cover the inside of the trench and the ground near by with dry earth, and sweep it all back into the pit.

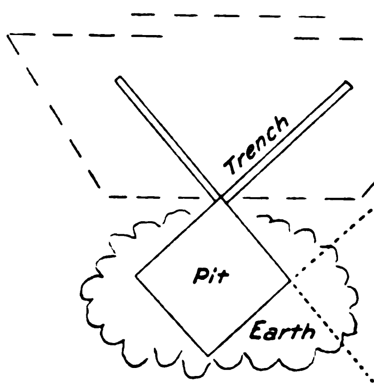

FIG. 20.

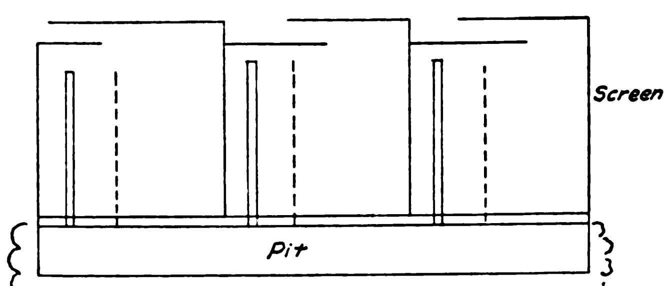

FIG. 21.

Then, again sprinkle the ground with dry earth as before, and leave it until just before the troops are expected to return, when the loose earth must be swept into the pit. A little earth must be put into the pit every morning and afternoon, and also at other times when urine can be seen standing in it. The screen should go across the trenches just where they join the pit, so that the latter is outside the screen. The trenches should be made quite straight and smooth, and should have a gentle but continuous slope towards the pit.

Night Urine Pit.—Always have a separate pit for emptying the night urine into, round which the receptacles stand during the day after they have been cleaned. A little dry earth is placed in the pit after the contents of the receptacles have been emptied into it.

Night Urinal Stand.

Make the stand of the right height, so that the receptacle is raised sufficiently to be convenient to use. Make the *sides vertical* and the top the *same size as the receptacle,* otherwise men cannot stand close to it and will foul the ground. If lights are not available, place a white-washed post near by, and white-wash the sides of the stand if it can be made of stones or brick.

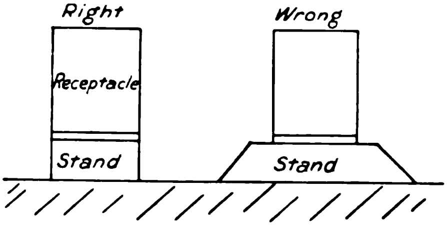

Fig. 22.

Incinerators.

As excreta were buried, incinerators were only required for rubbish and manure.

The ordinary horse-shoe shaped incinerator was used to destroy camp refuse and worked quite satisfactorily. *Refuse is burnt inside.* Care should be taken to dig out the earth for the wall from a place near the incinerator, so as to make a pit into which ashes can be put. Avoid hollowing the floor of the incinerator, as this increases the difficulty of cleaning as well as impeding the draught. In the event of the hole being too small for the ash, the latter may be placed in heaps and covered with a little earth. Keep the inner wall vertical. Heap the refuse, for burning, against the back wall, and do not pile it up in the centre of the floor.

Manure and Litter.

A large horse-shoe shaped incinerator was employed, the wet litter being spread out inside on the floor to dry and then *burnt on the outside* wall. Ash was not removed. An internal space of 20 by 30 yds. was found necessary for the litter from 650 mules. It is important that a sweeper should be continuously on duty to keep the wet litter spread out thinly to dry, and to throw it, when dry, on to the fire which must be kept burning all round on the outside wall. The fire should never go out.

LAYING-OUT A CAMP.

Each Indian infantry regiment laid out its camp in a different manner. From a sanitarian's point of view this has objections, as it is difficult to get a uniform sanitary scheme, and latrines (say) of one unit are liable to be close to the cook-houses of another unit. It would simplify the previous sanitary preparations of a camping ground, as well as the subsequent working when units are in occupation, if some recognized plan were adhered to.

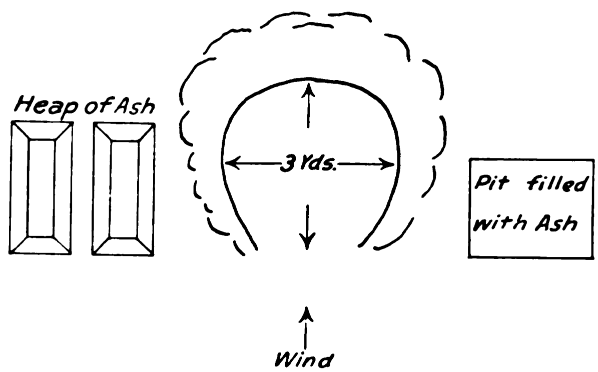

FIG. 23.

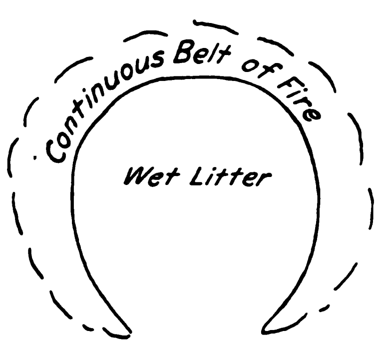

FIG. 24.

I have seen a suggested plan in a very old edition on encampments for Indian troops, but no recent or recognized one, such as exists for British troops in the "F. S. Pocket Book," and which differs greatly from the old one referred to. In the old plan, the officers are in rear of the men and close to their latrines; the cook-houses, too, are close to the latrines.

Most regiments take very much more ground than that laid down as

the maximum camp area, which is 130 by 105 yds. or, for a contracted bivouac, 105 by 90 yds. ("F. S. Pocket Book"). They extend backwards, have their cook-houses outside, and their latrines and urinals another 100 yds. further back. It would appear probable that if these regiments

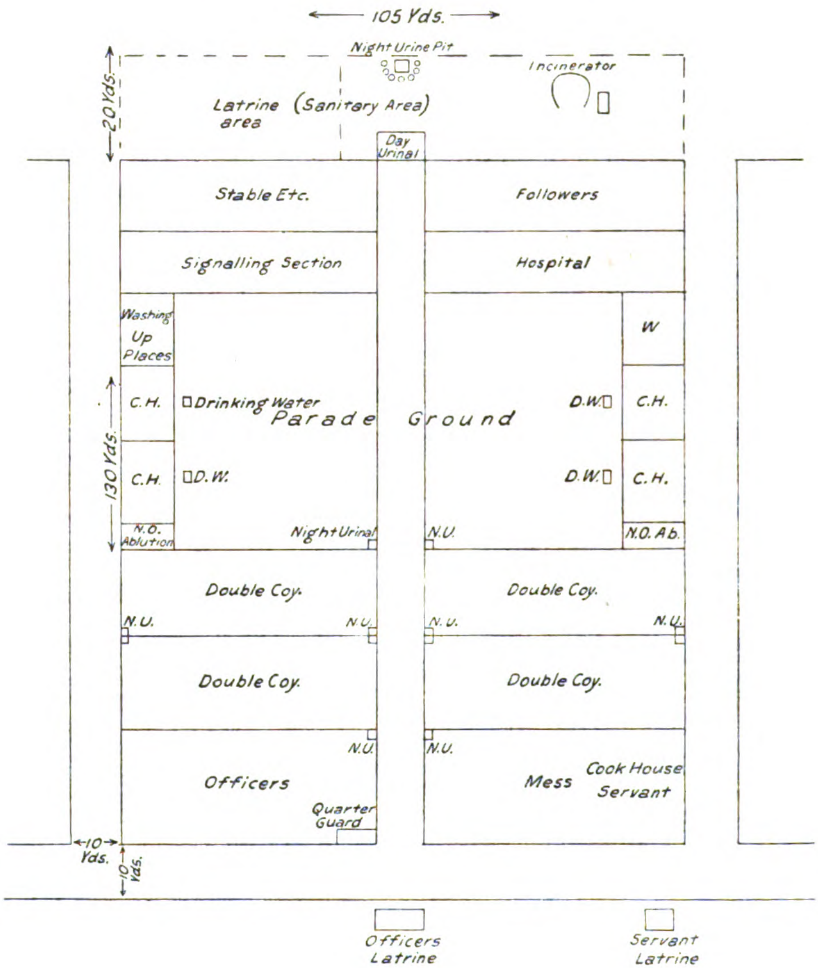

Fig. 25.

were restricted to, even, their maximum area, as would often occur on active service, they would find it difficult to make satisfactory sanitary arrangements.

Fig. 25 shows a method of laying out a camp as practised by one regiment. It was excellent from a sanitarian's point of view and the

maximum area was not exceeded, with the exception of the 20 yds. for the sanitary area. It is suggested that, if there is no regimental objection, it might be an improvement to have the parade ground, with cook-houses, &c., between two of the double companies instead of behind all four. This would give a greater distance between latrines and cook-houses.

Sanitary Condition of the Camp.

The sanitary condition of the camp was extremely good. Though the camp was occupied for three weeks, and though flies were numerous in the adjacent village and the village bazaar, there was scarcely a fly to be seen in any part of the camp.

Regimental Sanitary Detachments.

There was a marked improvement this year in the work of Regimental Sanitary Detachments throughout the camp.

All the Infantry Battalions, the R.A. and the S. and T. had well trained N.C.O's. and men.

The Mounted Infantry (Indian) and the sappers and miners did not have a trained R.S.D. working at first and their camps were very insanitary, especially the M.I.; later on, however, this was remedied. It is important that small units, such as these, should train during peace and employ both during peace and on manœuvres their R.S.D. as laid down in A.R. I. vol. ii, para. 893. One insanitary unit, though small, may originate disease throughout the camp, or be a breeding ground for innumerable flies.

The main criticism which I should like to make is, that there is a want of proper and systematic method of work in the R.S.Ds. The work is both executive and supervisory. The executive work is the digging of trenches, making drains, repairing screens, &c. The supervisory is over the sweepers at the latrines and urinals, at the incinerator, officers and men's cook-houses, and the whole of the area upon which its unit is encamped. The N.C.O. in charge R.S.D. should parade his men and the sweepers and give them definite orders. He should see that they do the executive work at specified times, and tell them off for specified supervisory duties. He himself should make a complete tour of the whole area at least once in the day, and if he finds any difficulty in getting defects remedied, he should report the matter to the proper authority. There should not be a single insanitary spot found in the camp, on inspection (say, by the M.O.) for which the onus could not be laid first on some definite person such as a particular sweeper, secondly on one of the R.S.D., and, thirdly, on the N.C.O. in charge R.S.D.

Sanitary Section.

This was the first time that a Sanitary Section had been mobilized in this Division.

The Force consisted of about 2,500 men, without followers, but as only Indian units (except a few M.I.) were taking part, as expense was a great consideration and an Indian infantry battalion had recently arrived in the Division, the following personnel was mobilized :—

Two N.C.Os. British; Two N.C.Os. and twelve men (Indian) from two of the Divisional Sanitary Sections, one N.C.O. and six men from the newly arrived Battalion, for instruction. Two sweepers and one *bhisti.*

The personnel was sufficient, with the exception of sweepers, of whom five were found to be required for a camp of this size.

The N.C.Os. and men worked hard, showed great keenness and were a great success. The way in which N.C.Os. and men of different castes worked together, and with the British N.C.Os. was very gratifying. They prepared the camp for the arrival of the troops as far as time permitted, but a full working week is required for a section to prepare a camp of this size. They supervised the sanitation of the camp and its surroundings, the drinking-water supply and the camp bazaar. They sent out a working party daily to do the executive work of isolated places, where there was no R.S.D., such as the camp of the L.G.C., the commandant, the directors, the railway station, &c. They kept a working party ready all day, to turn out and work in any part of the camp, or to assist any R.S.D.

Standing and Daily Orders were issued by the O.C. Section. Every N.C.O. and most of the men did a tour of duty as sergeant or N.C.O. for the day.

All the N.C.Os. received training in going out to some place, making a rough map and plan, and writing out the sanitary arrangements that would be required when opening up that place as a sanitary post.

They received practical instruction in opening up and conserving drinking-water under different and difficult conditions.

Field Laboratory.

A small laboratory was taken by the O.C. Sanitary Section. It was found of considerable use, especially in the examination of blood films. The field water analysis case was used in the selection of water supplies.

Health of the Troops.

The troops kept remarkably free from preventable diseases. There were a few cases of malaria, and one case of chicken-pox with sixteen contacts which were isolated in an infectious hospital, 200 yds. to leeward of the camp. All necessary precautions were taken and no other case occurred.

Meteorological Conditions.

The dry bulb thermometer (day) varied from 71 to 89, average 77.

The dry bulb thermometer (night) varied from 44 to 60, average 53.

The wet bulb thermometer (day) varied from 59 to 74, average 62.
The wet bulb thermometer (night) varied from 41 to 55, average 49.
The dew point (day) varied from 42 to 68, average 51.
The dew point (night) varied from 25 to 52, average 45.
The relative humidity (day) varied from 26 to 63, average 40.
The relative humidity (night) varied from 26 to 92, average 74.
The barometer varied from 26·45 to 26·67, average 26·57.

The weather was generally hot and dry during the day, and cool and damp during the night.

There was a smart shower for ten minutes one day, and a little light rain on two nights.

Echoes from the Past.

THE "DEATH MARCH" THROUGH THE KHYBER PASS IN THE AFGHAN CAMPAIGN, 1878-79.[1]

By Surgeon-Major G. J. H. EVATT, M.D.
Medical Staff.

CHAPTER I.

Introductory.

It is proposed in the following pages to place on record some experiences along the Khyber line and in Kabul during the Afghan campaigns of 1878-79-80, as it is probable that even the most trivial personal record may be of use to the future historian of that important campaign, for so far as one is aware the historian of that period has not as yet appeared.

Marking, as that campaign did, a great turning point in our relations to Central Asian questions, and in many ways forming a distinct starting point of Indian army reforms, it would be a great pity if no such history were written, as it would be full of interest and instruction in many ways.

One is not concerned to-day to enter in any way into the political causes of the campaign. The time has not yet arrived to deal in full with such questions. It is sufficient to say that throughout the year 1878 our relations with Afghanistan were evidently strained, and the reception by the then Amir Shere Ali of a Russian mission, and his refusal at the same time to receive an

[1] Reprinted from No. 82, vol. xix, *Journal of the United Service Institution of India*, 1890.

English one, precipitated a crisis, and by the beginning of October the imminence of the campaign was generally recognized. The final refusal of a passage way to the mission under Sir Neville Chamberlain at Ali Musjid by the Amir's officials led to an ultimatum and a direct declaration of war.

In October, 1878, the Army Medical Service was passing through that transition period between the regimental system of hospital organization and the newly introduced unification system, and at this date, although the hospitals were still regimental, the actual commissioning of medical officers in regiments had ceased, and one was in the indefinite and unsatisfactory condition of being a departmental officer attached to a corps.

In October, 1878, when the troops were ordered to concentrate on the Afghan frontier, the 25th K.O.B.'s were detailed for the Peshawar garrison, and on October 21, 1878, they moved by rail via Lucknow, Bareilly, Meerut, Umballa, and Mian Mir to Jhelum, which was then the rail head of the Punjab State Railway system since merged into the North-Western line.

It is impossible to describe the condition of Jhelum and its neighbourhood at this time. The railway was pouring in supplies from down country in great quantity, and there were scores of railway wagons crowding the small station, and piles of grain, rations, and every kind of supplies stored and packed all about the place.

The grand trunk road from Jhelum to Rawal Pindi, and on to Peshawar seemed to be simply one long line of bullock-carts and camels carrying loads, and troops were at all the camping grounds moving on to Peshawar. The ordinary postal carriage daks were almost impossible to obtain, officers ordered up on special duty found it most difficult to join their appointments, and it will be impossible ever to estimate what enormous sums of money were lost to the State, and what great delays occurred in obtaining supplies and reinforcements at the front by the want of the all-important railway line from Jhelum to the Khyber mouth.

A lady, the wife of an officer in a European regiment, tells her personal experiences at this time. By great luck she managed to secure a dak gharrie from Jhelum to Pindi, but the pressure of passengers being very great, the Jhelum Postmaster asked her to permit a native officer on urgent duty to travel on the top of her carriage, a common method of carrying servants in those days. She assented, and the native officer full of gratitude at her kindness came forward holding out his sword in both hands for her to

touch in the usual manner as a mark of his thanks. She, quite unused to meeting native officers, failed to understand what he meant, and thinking he wanted her to keep his sword as a guarantee that he would do her no injury during the journey, she took the sword from him, put it under her pillow, and gave it to him next morning on arrival at Pindi. It would be interesting to know what the native officer thought of the incident.

Marching from Jhelum the regiment reached Pindi in four or five days, passing on the way the Bengal Sappers and Miners and other corps moving to the front. Coming from a down country station, one now began to see for the first time the wearing of *putties* by the troops, a custom now so common, then quite unknown, and most people had never seen or heard of a "Sam. Browne" sword belt until they saw them worn by frontier officers on the road to Pindi and the front; the workmanlike dress now devised for field service did not then exist, and it was quite impossible when in *khaki* to say who people were. For some time at Dakka in the Khyber a Brigadier-General was taken for a chaplain, as he had very little beard, and nothing whatever distinctive on his uniform to show who he was.

The Elcho boot, now so universally worn in the field, was never seen on any officer until the campaign was well on, and the custom of having a lanyard to one's revolver was practically unknown to the average officer in the early part of the war. In tents, in camp furniture, in cooking utensils, as well as in dress, all seemed unprepared for the special character of this campaign in the highlands.

With the frontier force it was of course quite different; they, and especially the Guides, were well equipped, but they lived and still live ready at all times for the field. The example given to the army by these frontier corps abundantly proved that it is possible to devise a field service dress perfectly distinctive and becoming, and at the same time perfectly serviceable, and all that the army as a whole has since done is to level up to the standard already existing in 1878 in the frontier battalions.

The utter breakdown in dress that used to happen when a force was sent into the field need not now occur in India, as the field dress is practically complete. A story is told of the anger of an officer usually perfectly well turned out in cantonments, who, when dressed in the old khaki coat and going to buy stamps for his English letters, was addressed by a private soldier also at the post

office: "What a duffer you are to buy stamps, why don't you get the Colonel to frank your letter?" Later on reference is made to an incident where a well-known photographer in the Khyber took command of a convoy and was mistaken for a Bengal Cavalry officer.

The 25th K.O.B.'s remained at Pindi halting for a time, awaiting final orders, and the writer in the meantime was transferred to the 1st division (Sir Sam. Browne's) then mobilizing in the Peshawar valley.

While waiting day by day for a dak to reach Peshawar, the future Principal Medical Officer of the division, Deputy-Surgeon-General John Gibbons, A.M.D., passed through with a special dak. Coming from Allahabad where he had been P.M.O., and going on to Peshawar, he very kindly gave up a share of his dak, which enabled me to reach Peshawar with him.

The want of a bridge over the river at Attock was now and at all times during the next two years a most serious delay.

Peshawar was in a state of great excitement, troops and detached officers were daily pouring in, and the roads were filled with camel convoys moving out to Jumrood with supplies.

The medical officers passed through a wretched time in the few days that intervened between the arrival of the P.M.O. in Peshawar and the marching out of Sir Sam. Browne's division to Jumrood to attack Ali Musjid.

It was simply a killing time for the medical officers, and the confusion and the trouble long foreseen by any thinking men arose in this way:—

Although the unification of the medical department had begun in England in 1873, it was still in October, 1878, working on regimental lines in India.

Every one who had studied the question must have known that such a system would not work in war time up the Afghan passes, and when the war was drawing near, the then Surgeon-General Sir Harry Ker-Innes submitted a scheme for the present field hospital system to be introduced, based entirely on the English, that is to say, the German, French and Russian lines.

Some difficulty occurred in obtaining sanction from the Government of India for this change, and his scheme was not accepted.

At the very last moment, that is to say, one week before the army crossed the frontier, wiser counsels obtained, and a plan of field hospitals as opposed to regimental hospitals was sanctioned, but no one knew anything whatever of the details of the scheme

until 10 o'clock on the morning when Deputy Surgeon-General Gibbons arrived in Peshawar, and sought shelter in some vacant officers' quarters.

There were then in and around Peshawar numerous regiments and batteries ready for the field, with all their medical arrangements for the campaign complete on the regimental lines of organization.

The P.M.O. had with him but one single printed copy of the new field hospital scheme in the shape of rough proofs of a pamphlet called "*The Précis*," a name which no medical officer who served in the earlier days of the first Afghan campaign can ever possibly forget.

The P.M.O. on his arrival sent for all the medical officers of corps and batteries, and directed them to bring their clerks with them to his office, and there and then he explained to them as concisely as he could the entirely new scheme of field hospitals, and directed the medical officers to cause their clerks to set to work and copy out the printed scheme on manuscript from his single proof of the historic pamphlet.

This wretched delay alone caused much inconvenience, as every moment was of importance, and it is certain that few medical officers fully understood the drift of the new system at first. Practical experience, however, in a few weeks up the line of the Khyber soon taught them the good and the bad points of the scheme.

It became necessary, therefore, in accordance with this new scheme, in three days, and practically in the face of the enemy, to remove all the medical officers and all the medical subordinates from their battalions; to transfer all the native hospital establishments from their regiments to the little understood new creations called field hospitals; to hand over every grain of medicines, instruments and technical equipment, tents, books, documents, and to give and receive receipts on both sides; and finally to draw from the commissariat, barrack, ordnance, and transport departments the various equipments needed for the same units, the very existence of which was unknown outside the medical department.

If ever there was a case of "swapping horses in crossing a ford" it was here, and one can never forget the hurry, the worry, and the trouble these sudden changes caused; and there is no doubt whatever they acted most prejudicially on the health of the overworked P.M.O., and that this anxiety, together with the wear and tear of his heavy duties during the campaign, so broke him down as to

hasten his death, which occurred a few months after the second campaign was ended.

In the first place he had no secretary or orderly officer, nor personal assistant whatever to assist him, that fatal blot in our divisional medical arrangements; and his wretched baboo clerks, admirable as penmen under a punkah at Allahabad, had no relish whatever for the rocks and robbers of Afghanistan, and were in no hurry to join him, and when they did they almost immediately afterwards went sick.

As the Principal Medical Officer had constantly to go and see general officers and various other officials, and to make numerous inspections taking him away from his office, there was no official there to meet officers who called for orders, or to make reports, or to ask for explanations, and the confusion was made worse than ever.

When after all this the P.M.O. was seen with his own hands leading his camels from the transport lines, it seemed as if the cup was full and the last straw laid on the camel's back; and it became evident that the very first duty of the P.M.O. of a division in war time is to name at all hazards a secretary as his office staff officer, and a younger and more active officer as his orderly officer.

The Commanding Royal Engineer has a brigade major, the C.R.A. of a division has an adjutant, but the work of both these officers is more circumscribed and much more within a ring fence than that of the divisional P.M.O., who deals with every regiment, every hospital, and every sanitary question in his division. Without an assistant the work simply cannot be done, and it is essential to have the clearest conception of this matter.

Owing to the novelty of the system, at Peshawar there was the greatest difficulty in getting battalion and battery commanders to understand what their medical officers were doing, for in those days the phrase "*field hospital*" was not understood as it is to-day, and might have meant anything to the average officer, and indeed also to many medical officers. The commissariat, the transport, the barrack department, and the ordnance department failed to comprehend what this new indenting body was, and it was not until 9 o'clock p.m. on the night before the advance on Jumrood, that the tents for the field hospitals were drawn from the Peshawar arsenal.

All this hurry, this dire confusion, this wretched wear and tear of men's lives comes, and will come, from not preparing in peace for war, and so absolutely assimilating our peace routine and

organization and our war customs, that a soldier of any rank will glide from one into the other almost imperceptibly. How different it was with those perfect units, the frontier mountain batteries, and, indeed, with the frontier force regiments generally, and, above all, with the Guides, who go to war with as little trouble as one goes to a picnic. One learned from them more than ever the great lesson of the need of readiness for field work at all times, the be-all and the end-all of the soldier's existence.

CHAPTER II.

Ali Musjid.

Let us leave the field hospital marching out on the morning of November 19, 1878, towards Jumrood, and glance for a moment at some of the battalions concentrated at this time in and around Peshawar.

If it be not invidious, the palm for physical fitness and complete efficiency on the old long service army lines might be given to Tompson's battalion of the 17th Foot, now the 1st Leicester Regiment. They had come down direct from the Murree Hills, and were in magnificent physical form. They were probably about the last of the long service battalions of that army which was just then disappearing before the short service system, introduced a few years before, and better specimens of that old regime could not be seen; probably for weight and space occupied per man they were 30 per cent heavier and broader than the younger men of to-day.

In India one must never overlook the fact of where the regiments are stationed before a campaign begins. The 17th Foot, coming from the Murree-Abbottabad gullies, were in excellent form; other battalions, coming from malarious stations, were often quite the reverse.

When the campaign was imminent, the Rifle Brigade and the 81st Foot were both quartered in Peshawar, and they also moved forward to the front. Both battalions had suffered much from the then deadly Peshawar fever, but the Rifle Brigade, though sorely tried, held bravely on to the end of the first campaign. The 81st Foot, however, in a health point of view suffered severely. They literally went sick by half companies, and flooded the field hospitals.

The lesson of all this is most important to remember, for malarial fever, although it shows no death-rate, practically ruins a

force, as the least exposure on picket or outpost duty induces ague, and the man must be taken into hospital.

The 51st K.O.L.I. (now the 1st King's Own Yorkshire Light Infantry) also marched into Peshawar at this time and were in excellent form. They had quite lately been on the Jowaki expedition, and in a measure had had their baptism of fire. In their medical inspection at Gandamak in April, 1879, when they were detailed for the proposed rapid advance on Kabul, they were found very fit indeed, having hardly any rejections.

The greater age of the regimental officers of the army in those days was very marked. By comparison with the average age of to-day, there were many old men still commanding companies.

On the morning of the advance on Ali Musjid, the *junior major* of a European battalion engaged had then thirty-eight years' full pay service. He had turned back from the advance on the fort to send in his papers to retire from the Service, saying, "I feel my position acutely, but I cannot go up the hill."

His senior major was so old a soldier as actually to be commanding a brigade in the force.

In nothing is the army more changed than in the age of the officers. On November 18, 1878, Sir Sam. Browne had a meeting of staff and commanding officers in Peshawar to explain his proposed plan of attack on Ali Musjid. The P.M.O. was present, and heard confidentially of the proposed turning movement by the Tartara route being decided on, and on the morning of November 20 the division as a whole concentrated at Jumrood and pitched a divisional camp, just in front of the then ruined Sikh fortress now so completely remodelled. The field hospital also marched out and pitched its camp with the division. Even thus early in the campaign one could see how hopelessly unfit our heavy plains hospital equipment was for mountain warfare. In the first place the tents, like those of all the European troops, were the huge E.P. pattern, heavy, cumbersome, and unfit for mule or camel carriage in the highlands. Again, all the equipment was packed in unwieldy camel trunks difficult to load, difficult to unload, crushing a fallen camel to the earth, and in which it was impossible to get at any small article.

No mule or mountain equipment for field hospitals of any kind existed in India, and no one knew on what lines to advance to make a mobile field hospital for mountain warfare.

The changes made in our war hospital material since 1878 have been very considerable, and we may safely say that as far as type is

concerned the broad lines of efficiency are laid down. Details of course in this as in all departments still remain to be dealt with. Want of experience, and want of careful thinking out one's requirements in peace for war, will account for most of our troubles in 1878 on these heads.

At 6 p.m. on the night of November 20, 1878, the turning brigades began to move out of camp, and any bystander would be particularly struck with the fitness of the 17th Foot.

A second body of troops left the camp about midnight on the same route, and at 7 a.m. on the next morning the main body, moving up through the Khyber mouth, got under weigh, and gradually moved away over the three miles of plain that intervenes between Jumrood and the mouth of the pass.

And now those in the field hospital were to feel how unready they were in equipment for active work, for that morning, early, Sir Sam. Browne rightly issued an order that no loaded camels were on that day to enter the defiles of the pass, as they would encumber the column. As the field hospital equipment of every kind was entirely packed on camels, it had simply to halt on the Jumrood camping-ground while the troops marched off to the attack.

A gallant soldier commanding a gallant regiment remained behind that day to hold Jumrood. The soldier was Colonel Armstrong, and the men of his regiment, the 45th Sikhs, an admirable body who did first-rate service during the campaign, but were destined soon after the war to lose, while still a young and active man, their gallant leader, a distinct loss to the Indian army.

The disappointment and vexation caused by this order about camels was very great to the medical officers, who stood by and saw the troops go up to the fight with only a single medical officer with each battalion, and no bearer company or any field hospital whatever.

Deputy-Surgeon-General Gibbons, the divisional P.M.O., remained behind with the field hospital at Jumrood, and in this act no doubt he was wrong, as the true place of a P.M.O. is with the general on whose staff he is, so as to issue orders for the care of the wounded and the disposal of the sick.

The morning was thus passing away, and while eating out one's heart with vexation at being shut out of the fight, it seemed that it would be possible to extemporize some ambulance aid for the division in front without using the camels or their cumbersome equipment.

It was accordingly suggested to the P.M.O. of the division that it would be well to prepare loads of blankets, brandy, beef-tea, and reserve dressings for the wounded, and pack the whole in doolies and so overtake the column.

The P.M.O. readily assented, and, applying to Surgeon-Major Ramsbotham, who was in actual charge of the field hospital at the time, the writer obtained the necessary supplies as well as the help of a young apothecary to assist. There was, however, no escort, nor any arms whatever with the party, and moving out of the Jumrood camp lines, the rolling ground was rapidly crossed, only a few armed hillmen being met with evidently on the look-out to see how the day was going, and we caught up the rear-guard of the division struggling up the stony track that forms the entrance to the historic Pass. The 6th Bengal Infantry that day formed the rear-guard, and applying to the commander of the guard, Captain Birch, an escort of a Havildar's party was obtained, and we pushed rapidly along the column crowded in the narrow defiles, and were soon well to the front. Just below the Sherghai heights the party had to halt for a time to set the kahars at work to assist Captain Graves, who was in charge of the wagons of the elephant battery, and whose unwieldy vehicles were jamming in the narrow tracks. This well-known and popular officer died in the following July in Peshawar, in the interval between the first and second campaigns.

Some miles of gradual ascent along the winding road takes one almost suddenly out of the defiles of the Khyber on to the open plateau called the Sherghai heights. These are comparatively open and rolling hills from which one commands a good view of Ali Musjid heights and fort, and of the rocky cliffs that directly overhang Ali Musjid, and well away to the left when facing Ali Musjid run the green valleys which lead towards the Bazar valley. Wilson's elephant battery was in action against Ali Musjid from a level space on the Sherghai heights, and at intervals a shrieking 40 lb. Armstrong shell went flying over the intervening valley, and either struck against the stony profile of the fort, or dashed against the masses of living rock behind it, leaving a great white patch where it struck, and a few missing both fort and rock fell behind Ali Musjid in a gorge where a number of Afghan troops were under canvas and suffered some loss from the fire.

The fort itself presented a very low and almost undistinguishable profile merging in the grey rock on which it stood, and by which it was surrounded, and was in every way a difficult object for any

artillery to hit. I/C Royal Horse Artillery was also in action from another part of the heights, and the Afghans were replying by cannon shots which came dropping in amongst the troops, and now and then rolling amongst the doolie bearers who were clustered on the heights.

One brigade of our infantry was lining the heights towards the right looking from Sherghai towards Ali Musjid. This was probably Browne's brigade, as the 51st were in that direction, while Appleyard's brigade, consisting of the 81st Foot, the 27th Punjabis, and the 14th Sikhs, were more to the left, again facing towards Ali Musjid. Every one was waiting anxiously for the development of the turning movement by the brigades which had left Jumrood the previous evening, but hour after hour went by and there was still no sign. The brigades were at this time struggling with the increased difficulties of the route, and could not possibly appear on the scene. The short November day was already closing in, and the General, resigning all hope of the turning troops appearing on the scene, gave orders for a direct attack to be made by Appleyard's brigade on the sungah-crowned outlying heights that acted as a kind of rampart to the fort, and which were lined with Afghan riflemen.

No one can positively say whether this attack was made by Appleyard's brigade as a whole, or whether the sepoy battalions alone attempted the assault.

The point in doubt is whether the 81st Foot were ordered to attack at the same time as the 14th Sikhs and the 27th Punjabis, or whether they were held in reserve to support the attack as it developed. It seems, however, that they did in part advance and were recalled. The accounts vary so far as I am aware; but this I know, that no European soldier came back wounded from the assault, nor was any dead European soldier found on the hillside next morning, so that it is evident the brunt of the attack did not come on them but on the native regiments of the brigade.

These two regiments seem to have gone forward to the attack, led gallantly by Captain Birch and Lieutenant Fitzgerald, and were received by a heavy rifle fire, which killed the two named officers, wounded Captain Maclean of the 14th Sikhs, and caused casualties amounting to fourteen or fifteen killed, and about forty wounded in the two regiments.

As the divisional P.M.O. was not on the field, and the party was independent of any regiment or corps, it seemed that it would be better to get nearer the front, and accordingly the bearer company

moved down the sloping ground into the stony bed of the Ali Musjid river, and pushing along the level ground, reached the ground at the foot of the slopes where the assault was being made.

While still moving forward, Colonel Maunsell, of the Bengal Sappers and Miners, who was C.R.E. with the column, came up and said the wounded of the attacking brigade were all coming down into the bed of the river, and in the most lucky manner they came down actually on the very spot where by the merest chance help had arrived. They were all Sikhs and Punjabis of the 14th and 27th Regiments.

The men came down direct into the bed of the river, but no reserves could be seen, nor was their regimental medical officer anywhere about, and it fell to the share of the Jumrood help and to that of Surgeon-Major Creagh who was in charge of I/C Royal Horse Artillery to look after them. I/C Royal Horse Artillery had moved down off the heights, and spent the night in bivouac in a sheltered defile opening up off the river.

By absolute good fortune there were plenty of blankets, plenty of brandy, and other medical comforts, and in consultation with Dr. Creagh, an able officer since retired, the wounded men were cared for very thoroughly, and after dressing their wounds and giving them some brandy, covering them with blankets, and giving them some sleeping medicines, by 11 p.m. they were all at rest and slept fairly well during that long and anxious night. It must have been about 5 p.m. in the evening when the wounded began to come in, and shortly afterwards we were greatly surprised to see Surgeon-General Ker-Innes come down the side of the pass with Mr. Archibald Forbes and Mr. Simpson of the *Illustrated London News*, and descend into the river bed. There was now no chance of mistake as to who he was. He was dressed in the undress uniform of his rank, gold cap, and cross-belt, and looked very spic and span indeed amongst the sombre khaki surroundings.

He inquired at once how we came to be there, and what we were doing, and above all where was the field hospital, the child of his own creation. He then heard of the *contretemps* as to the camels, and how we came to be up in the pass. He was excessively put out at there being no field hospital on the field, gave some general directions about the wounded, and later lay down to sleep a few yards off on the hillside.

The native wounded behaved splendidly, as they always do, and took their troubles with a light heart; *Shábásh kuch parwá nahin* was the burden of their cry, and they stood the pains of the dressing excellently.

There was, of course, the usual struggling to get to the doctor, and to try and draw the doctor to them, and there were, as there always is, a certain number of over-solicitous comrades, whose intense sympathy with the wounded entirely overbalanced their desire to return to the front and the bullets. These latter men were utilized as a protection against any prowling Afghans, and next morning we dismissed them to rejoin their battalions.

All through that anxious night, when none seemed to know what had really happened, nor what was the true state of affairs, officers and orderlies came passing by the bivouac, and asking in vain where they could find the General, as they wished to make reports and ask for orders; but no one had any idea at all where he was, nor indeed that any attack had been made, until the wounded said that all their officers were killed, and even named Captain Swettenham of the 27th Punjabis, and Major Terry of the Borderers, attached to the Punjabis, as killed, mere reports which turned out to be false. The difficulty of finding the General Commanding at night time will always be a difficulty that needs to be specially guarded against, especially if night attacks now so much spoken of ever become realities.

In the early dawn the Surgeon-General came up, and ordered the wounded to be got back at once on to the Sherghai heights, and us to hurry up again to the front. "We are going to have warm work," said he, "an assault in force is ordered," and he evidently spoke with authority.

Accordingly the wounded were rapidly taken back up the bed of the river and up the sloping paths to the Sherghai heights, but there was no hospital there, nor any medical officer to take them over. There were, however, abundance of doolies and kahars left behind by the regiments, and transferring the wounded, the kahars were simply told to "*Jao Jumrood*," where eventually the wounded arrived without escort or attendance of any kind on the road. Their arriving at Jumrood safely was another piece of good fortune, as a few days afterwards, when the tribesmen were on the war-path, they would in all probability have been cut up. At Jumrood they fell into careful hands and were looked after by the medical officers of the native hospital there, and it was afterwards said that when they saw the clothes of the wounded covered with candle-grease which had dropped on them during the dressing the previous night, they felt what a troublesome thing it is to dress wounded by candle-light on the field.

Having freed the doolies of the wounded, the detachment

hastened back again down the slope into the river bed, and it seemed that troops from every point were converging on Ali Musjid, and every one was full of excitement with the idea that the assault would be made in force, and the place carried by storm, as it was said that the tribes were assuming a threatening aspect, and that Cavagnari insisted on prompt measures being taken to capture the place.

While hurrying along the bed of the stream towards the open space at the foot of the Ali Musjid fort, and expecting every moment to hear the cannon begin, an officer in khaki came running from the direction of the fort, and crying out to all he met that the fort was empty and that the Afghans had fled in the night.

Hurrying onwards we at last reached the little white mosque of Ali that gives its name to the place, crossed the stream that runs at the base of the rock, and commenced to ascend the broken pathway that then led to the foot, where were also the General and his staff moving upwards towards the fort.

On entering the fort everything was found to be in complete ruin. The 40 lb. Armstrong shells had knocked the place to pieces, and the bastions at the angles were in ruins. In one of these a 40 lb. shell had burst, and four Afghans who had been sitting round a dish of *pillau* were smashed to pieces by the explosion.

Posteens in quantities, broken arms, cooking pots, and ammunition lay about in confusion, and twenty pieces of artillery were lying about in the fort and a certain number were in line at the foot of the hill.

There were a number of sick Afghan soldiers lying about, wretched-looking men, evidently victims of the Ali Musjid fever, who had been abandoned when the garrison fled in the night by the Bazar valley and the hills on the right of Ali Musjid, looking from it towards Sherghai.

Of loot in the real sense there was none, and if one managed to get an Afghan knife, a koran, a drum and drum-sticks, and a pile of manuscript returns, which turned out to be the company accounts of the soldiers, one was supposed to be lucky.

Posteens could have been had in quantities, but distance lent enchantment to the view of them, and they were in a terrible state of filth. In the gorge behind the fort there was the Afghan encampment, into which some shells had dropped.

The masses of troops which had been converging round Ali Musjid for the assault were now concentrating on the bed of the river below, and for nearly a mile the place was crowded with

troops, fires began to be seen, and preparations for breakfast were developing.

Many very fine mules were running loose about the place, which had apparently belonged to the Afghan mountain batteries, and although a few intelligent persons had annexed them, they were soon after compelled to hand them over to the transport department.

Some cavalry were sent forward up the pass, towards Landi Kotal, but the main body remained halting on the dry bed of the river during the day. The bodies of Captain Birch and Lieutenant Fitzgerald of the 27th Punjabis were brought in off the heights where they had been killed. They had lain on the hillside all night. It was at first intended to bury them at Ali Musjid, but wiser counsels prevailed, and the bodies of these gallant men were sent into Peshawar for burial.

While examining the bullet wound of Captain Birch, which was in the region of the heart, it was found that a locket containing a picture of his wife had been carried into the wound by the bullet.

The Surgeon-General sent round to the various corps and batteries to collect returns of the killed and wounded. The killed were about fourteen, and the wounded between forty and fifty.

All through the day people were anxiously waiting for the field hospital to arrive from Jumrood, but it never appeared.

The Surgeon-General (Ker-Innes) was particularly put out at its non-arrival.

That night we slept in the bed of the river, and in the early morning the troops began to move up the pass towards Landi Kotal.

The eagerly looked for field hospital arrived during the night; it had bivouacked down the stream nearer the Sherghai heights.

With the arrival of the field hospital the separate existence of the temporary aid on the field ceased, and it reverted to the field hospital, where Surgeon-Major Davie, medical staff, was commanding, Surgeon-Major Ramsbotham and Surgeons Cornish and Ryan, with others, being with him.

A site for the field hospital camp was obtained on some level ground on the left bank of the Ali Musjid river, and there we formed a field hospital for the European sick of the entire division.

It should never be forgotten in choosing battalions in India for field service, that a regiment fully saturated with malaria is unfit

for most campaigns, and it is quite certain in general experience that a regiment which has suffered from malaria will also in cold climates very easily fall a victim to pneumonia.

When Sir Sam. Browne's main body moved on to Dakka, the 51st K.O.L.I. and the 6th Bengal Native Infantry remained behind to hold Ali Musjid, and for some time Wilson's elephant battery remained encamped in the open on the Sherghai heights. They were frequently fired into, and later on a company of infantry was sent up from the bed of the river to act as an escort for them.

The army in those days was certainly far from being as ready for war as it is to-day. In dress, in equipment, and in inherent knowledge of military precautions in the field, it seemed distinctly untrained and unready by comparison with to-day.

Even at Ali Musjid one could see this. The camp was frequently fired into, and at first certainly little or no attempt at outpost or picket protection existed.

Over and over again the gunners who were employed in removing the Afghan guns from the Ali Musjid fort were fired at by tribesmen close by the camp, and the gunners were seen to quit the guns and try to reply to the enemy with carbine fire, while all the time two fine regiments were lying, little if at all employed, in the bed of the stream a quarter of a mile away. A company of infantry could have paralysed any such attacks had they been sent out, but in this, as in several other matters, there was want of initiative, or at any rate of right initiative at Ali Musjid. A very brilliant episode, however, was the repulse of a bold attack on a picket of the 51st K.O.L.I. The picket was commanded by Lieutenant Johnston of the regiment, and the enemy were driven off.

The tribesmen were particularly bold in attacking convoys, and the road from Jumrood to Ali Musjid, and from Ali Musjid to Landi Kotal was entirely unsafe, several convoys being attacked, and men were killed in detail. The system of holding the line of road by permanent detachments scattered along it, as opposed to convoy escorts alone, seemed far preferable. For this duty, second or third class troops do very fairly, and save enormous labour to the troops in general.

CHAPTER III.

DAKKA.

THE Surgeon-General went forward with the head-quarters staff to Dakka, but the divisional P.M.O. remained behind at the field hospital at Ali Musjid.

Day after day the field hospital remained behind at Ali Musjid, and no section or detachment of it was sent forward to the front, thus leaving the troops at Dakka without any hospital accommodation.

The Surgeon-General eventually came back to Ali Musjid, and the divisional P.M.O. proceeded to the head-quarters of his division; when he reached Dakka he found that the sick were accumulating in the Dakka fort in a temporary hospital organized by Surgeon-Major Creagh from his battery equipment, but without attendants, or drugs from the field hospital.

Telegraphic orders were then sent down from Dakka for a section or division of the field hospital to move up to the front, and it became a question who would be the lucky man to go forward.

Surgeon-Major Davie, who then commanded the field hospital, decided on sending a fifty-bed division, and by a lucky stroke it fell to the writer's lot to move forward, and we marched from Ali Musjid with Surgeon Shaw, Medical Staff, one apothecary, and a team of native attendants. There was, however, no hospital serjeant nor writer, nor any European orderlies whatever, and the want of these men was felt very much indeed. It was quite a pleasant march up the Khyber, which beyond Ali Musjid is very picturesque and striking, and passing the great Buddhist *Dagoba* which crowns the summit of the defile, we reached Landi Kotal, and changing the escort pushed on the same night down the steep roadway that leads to Landi Khana, and reaching that post bivouacked for the night under the walls of the rude fort held by the 20th Punjabis.

The hospital men were perfectly unarmed, and lay down outside the rude walls, and it is a wonder some of them were not cut up as many were, close to, or actually in the camps, during the campaign.

Early next morning the hospital moved down the sloping road that leads into the comparatively open plain where the Khyber Pass ends, and the defile opens out on the valley of the Kabul river.

It moved along without any attack, and we had no escort whatever, for things were rather easy-going in the early days of the campaign.

When about a mile and a half from Dakka fort, and a partial view had been obtained of a valley which opens up to the left as one approaches Dakka, there was well to the left a cloud of dust, great shouting and crying out, and out of the dust came a crowd of men mounted on ponies and crying out "*larái*," "*larái*," some riderless troop horses, and a few sowars. It turned out to be a grass-cutting party of the Guides which had been attacked at the head of the valley by some of the tribes. They (the latter) had killed a sowar and driven off the grass-cutters.

A sepoy battalion was then encamped close to the mouth of the valley, and they immediately fell in and sent forward a company to skirmish up the valley.

The alarm soon reached Dakka fort, and very soon after a squadron of the Guides turned out and crossed the hills to the head of the valley, hoping to cut off the marauders.

Pushing on to the fort, our arrival was reported to the P.M.O. and to the staff officer of the head-quarters staff who were occupying a central building on the Dakka fort said to be the quarters of the Afghan commandant.

The fort of Dakka may be considered to be the Amir's garrison holding the Afghan mouth of the Khyber, where the pass opens out into the valley of the Kabul river opposite the Mohmand village of Lalpoora.

The fort itself is a kind of miniature Sherpur, as Sherpur was in 1880. The same rectangular form, the same thick earthern wall with bastions at intervals enclosing very substantial mud buildings for the lodgment of soldiers. It formed a capital place for our "*étappen*" post on the line of communications, and during all the time I was there—several months—not a single bullet entered the fort, a great comfort when one remembers the very constant night firing into camps at other posts. There was ample and very convenient commissariat storage, and the hospital located in the fort eventually became very comfortable.

The hospital was assigned an angle of the fort about 150 yards on each side, and Surgeon-Major Creagh handed over the sick which had already accumulated in the spare rooms of the Afghan barracks.

The camp was pitched that afternoon, and next morning there was hoisted the Red Cross flag, the first that had ever been flown so

far in the Khyber, and by noon Sir Sam. Browne came and inspected the hospital, and said it was fairly complete. It, however, had its inherent weaknesses.

In the first place it had no hospital serjeant, a very essential element, as by an antiquated rule the medical subordinates did no clerks' or statistical work, and however many of them there might be one could not so employ them. There had been two or three of these serjeants with the head-quarters hospital at Ali Musjid, but one was not obtained for the hospital when marching away. In such a case as that one has to try and develop assistance as best one can.

Going accordingly to Colonel Tompson, who then commanded the 17th Foot, I asked him to let the hospital have a serjeant who could be trained for the work. He said: "I have forty non-commissioned officers employed on various staff billets, and I can't spare you a man."

This seemed hard at the time, as it was the advanced field hospital and was practically in front of the enemy, but there is no doubt he was right.

If the medical service claims independence, and demands autonomy, it ought to accept responsibility in full, and not have to go about begging for favours in every direction as it so constantly has to do.

After great trouble and delay a rheumatic but intelligent corporal came sick, and I managed to develop him into a clerk, and rejoiced greatly. The rejoicings, however, were but short-lived, for the divisional P.M.O. was in a similar condition as regards clerical help, and any P.M.O. in any campaign may be in a similar plight to-morrow. Two eminently respectable cantonment type of baboos had come up with him as clerks for the campaign.

Anything more unwarlike, more inefficient, and more unsoldier-like cannot be imagined than were these followers.

The biting cold of December days, and the perpetual night firing in the Khyber were not to their fancy, and they both conveniently got sick and returned to the repose of the Allahabad cantonments. This wretched system of baboo clerks failed, as it always must fail in a real campaign. These miserable followers, unarmed, undisciplined, waiting to be cut up, are the curse of an Indian army, and although everywhere condemned, still exist, but should cease by the provision of clerks from regiments and battalions, who should be placed on the unattached lists during good behaviour.

The P.M.O. being thus left single-handed and deserted by his

clerks, noticed the rheumatic corporal, and directed his transfer to his own office, and the hospital was again left desolate. But this is not war as one understands it. It is chaos, confusion, and certain failure in the field, and should not occur in an army worthy of the name. The placing of the follower on a military footing is a most important question for future great campaigns.

Later on the hospital picked up a serjeant, and a good one, too, and he remained with it for some months doing good service, a soldier and a clerk as well.

The native establishment given to work the hospital was wretchedly bad—literally and actually the lame, the halt, and the blind, as Falstaffian a corps as any man could ever see, without discipline, without uniform, or drill, or arms, or anything to distinguish them from the coolies of the Mian Mir bazaar.

With this utterly scratch team one was asked to run a field hospital, to take care of human life and to nurse the sick, things which are not possible without trained and disciplined, well paid and chosen men. To-day the lines of a corps of attendants are being gradually developed, but there is only one model to copy, and that is the model of the army. In its discipline, in its drill, in its training in peace for the routine of war, in the establishment of units identical for the one as for the other, in the knowledge of the matériel and the personnel, in the power to blame or praise some one person for failure or success, on that subordination of individuals to a chief so that success may be obtained for the army as a whole; by these means and on these lines alone can success come. The more one differentiates between the medical service and the rest of the army to which it belongs, and the more one forgets the discipline, the routine, and the methods of the soldier, by so much does one organize disaster and guarantee breakdown in the field. When the then Commander-in-Chief, His Excellency Sir Frederick Haines, came through Dakka in February, 1879, he said: "Now is there anything you would like to bring to my notice, speak out and keep back nothing." He was told: "The native attendants are as bad as they can be." Sir Frederick agreed, and said a scheme was then being prepared to improve them.

Later on such a scheme was promulgated, but it still leaves these men as unarmed followers, with less food than the sepoy, although their duties are most onerous and cover day and night, and their rate of pay is still below even the moderate sepoy standard, rendering it difficult to obtain good men.

They can never be anything but a weakness to our forces until they copy the army.

Until every field hospital needed for war exists as a permanently organized unit in peace, doing duty it is true as a station hospital in cantonments, but moving to war with the same personnel, there must be great weakness in efficiency.

Just as a field battery exists in peace for war, so should a field hospital, and when war is declared it should move with its own officers, its warrant officers, its soldier clerks, European soldier nurses, native attendants, tents and equipment, and its nucleus of transport waiting for expansion in the field.

To know one's personnel, to know whom to trust and whom to distrust, to know who is steady and careful and who is the reverse, these things are enormously important in war; but if units do not exist in peace as in war, how are they to be known, and how can work be carried on with confidence? Decentralization here is of supreme, nay, vital importance, but then it should not be *disintegration*, and in the identity of the war and peace unit we have the keynote of success.

It would be quite wrong to allow in any way that the hopes and the dreams of the reforming party in the medical service have as yet been realized, but progress is being made under the lessons learned from each campaign.

A few days after the hospital marched into Dakka the force under Sir Sam. Browne moved forward towards Jalalabad, leaving the 17th Foot, the 45th Sikhs under Armstrong, and Hazlerigg's battery of field artillery in garrison to hold Dakka fort.

Colonel Armstrong of the 45th Sikhs became commandant at the post, and was in every way a good man for the billet.

The writer was senior medical officer with him for several months, and never had any trouble about duty or work; once only there was a slight difference of opinion, and as it was instructive it may be referred to. When Sir Sam. Browne's force moved away from Dakka the place was in a dirty state, and required careful sanitary supervision. The camels and other cattle were dying badly as they did throughout the winter. Surgeon Ratigan, M.S., was nominated to act as executive sanitary officer to make inspections and send in reports. The reports of dead camels were urgent and numerous, and I moved the commandant as to their burial.

One evening a train of camels and the driver came to the field hospital with a receipt for Dr. Ratigan to sign, as it was intended that he should become camel burier to the force.

To this I naturally objected, and requested that the transport

people be ordered to bury their dead animals, and that in carrying out other sanitary work the staff officer of the commandant should be the executive, the medical department being the advising body only.

To this the commandant assented, of course, and the matter ended.

There is no doubt that the conservancy of the camps in a campaign like that of the Khyber, moving over a narrow roadway, is very important, and a definite fatigue under the commandant's orders seems needed.

In any campaign the definite organization of the conservancy of posts becomes a very important matter, and in an army where caste prevails often causes difficulties.

While the sick carriage was being arranged for the return of the 14th Sikhs, I met for the first time Brigadier-General Tytler. I confess I had no idea who he was. The field dress in those days was very undefined, and every man seemed to be a law unto himself in the matter. As the Brigadier-General wore no badges and had very little beard, I thought him a chaplain of the force.

I thus met for the first time one of the most singularly perfect types of the Indian soldier. Few officers ever were so loved, so entirely trusted in as was General Tytler. Most considerate, most just, demanding duty to be done with exactness, and with a manner which compelled obedience, there was no officer in whom officers and men had such perfect confidence and reliance. He had a singular calm in his manner and was perfectly unmoved in every position in the field, either in or out of fire. He had the keenest consideration for his men, and all who served under him regard his memory to this day as a great bond drawing them together. To the great loss of India and the army his fate was to die of pneumonia in the Zaimukht expedition during the second Afghan campaign in 1879.

The hospital had arrived in Dakka on December 8, 1878, and about this time continual attacks were being made on convoys in the pass by hillmen from the Bazar Valley, and largely, it is said, by the Zakha Khels.

These hardy tribesmen from the crests of the hills watched the narrow path of the Khyber as it wound along, and woe to the straggler, the listless camp follower, the doolie bearer, or the footsore sepoy or private who lagged behind the convoy. These hawks swooped down from their hill-tops, and the murderous Afghan knife soon did its thorough work. The grass-cutters and the camel men

when out grazing their cattle were special victims of attack, and the wounds inflicted on them left no room for medical aid, they cleft the skull as though it were an eggshell.

The mass of unarmed followers in the Indian army is a most serious question not yet fully tackled, and the next great war will certainly force the question forward in a marked degree, if not fully dealt with beforehand.

In thinking of these days one always remembers, as a picture impressed upon the mind, seeing Major Cavagnari, who was political officer with the force, addressing a crowd of the local tribesmen in the pass, and warning them that if the outrages proceeded punishment would result.

He was on horseback dressed in the khaki uniform which all the frontier men knew so well how to make into a most soldierlike and serviceable uniform, and around him were grouped those savage mountaineers, in posteens or their coarse friezes, and armed with jezails, and here and there a muzzle-loading Enfield rifle, their razor-like knives, and a few shields.

It was simply another type of the same old scene which has gone on in the world since time began, savagery face to face with civilization, and the types of both were in this example as well marked as need be.

CHAPTER IV.

The Bazar Valley Expedition.

The attacks on convoys continuing, it was determined to send a lightly equipped column into the Bazar Valley to punish the marauders in their own home. A strong force under General Maude and the 2nd division staff moved across the hills from Ali Musjid, and Brigadier-General Tytler was ordered to co-operate from Dakka with a smaller column consisting of a wing of the 17th Foot, the 45th Sikhs, some of the Guides, and some Sappers and Miners. It was necessary to detail a medical officer for the 17th Foot, and Surgeon C. P. Turner, M.S., who was then doing duty in my hospital, was nominated, but at the last moment he fell sick with quinsy, and the writer proceeded himself with Tytler's column.

This was the first of those small expeditions which continually marched off from the main line of the Khyber, either for purposes of reconnaissance or the punishment of marauding villages, and which formed a special feature of the campaign.

The column left Dakka on the afternoon of December 19, 1878, and marched onwards until nightfall, when it bivouacked on the hill-sides, and had no fires or lights of any kind. Here it rested until 3 a.m. The dry, clear, frosty air of the winter in the Khyber was very invigorating, and the electrical condition of the atmosphere most marked; as one pulled one's blanket over one that night, it crackled and sparkled with electricity like an electric machine.

Next morning the column surprised some villages and began the blowing up of the village towers (so common an occurrence throughout the war) and in the afternoon after a toilsome march over a ridge some 5,000 ft. high, and covered with English flowers and with mistletoe on the trees, it opened up a view of the distant Bazar Valley, and began descending towards it, by night-time reached it, and bivouacked outside the walls of a large village. Women, children, cattle, movables, all were gone, and perfect silence reigned over the place.

As darkness closed in the soldiers lighted their cooking fires of the spare wood and rafters lying about, and soon the place was aglow with the flames.

That night the writer sat by the fire where General Tytler, with Major Gordon, his Brigade-Major, and Captain Rogers, his A.D.C., formerly his adjutant in the 4th Gurkhas, were gathered.

The General spoke of his former campaigns, of his regiment, and of our present expedition. But what has impressed itself most firmly on my memory was when he spoke of the medical service of the army.

He said no general officer had yet appeared in our army who knew how to appreciate at its just value an efficient medical service. They still remained the "step-children in the military family," and much more to the same effect. Of course the writer agreed with him, all who know do agree with the truth of this idea.

Napoleon, who raised Percy and Larrey to be Barons of his empire, and in his will referred to Larrey in words which can never be forgotten, had fair views on the subject, considering the age and time. Sir John Moore, a clear-headed soldier and army reformer, had glimmerings of the matter. Wellington, ever hard and unsympathetic though he was on all army questions, paid them some well-earned compliments; but it remained for Dalhousie, our greatest Indian statesman, and the chivalrous Outram, the knight *sans peur et sans reproche,* to give the clearest and the most outspoken expressions of sympathy with the medical service. Slowly the conceptions

of Dalhousie are being realized, but so far as one can see, the motive power comes entirely from within, and not from any help from without the department, and perhaps after all this is the true progressive path. All external influences may have no real foundation with the corps itself, if reforms come from without; but it still waits the appearance of the leader who will fully accept it into the family it has served so devotedly.

During the long December night not a shot was fired by the troops or the tribesmen, and next morning the staff rode over and opened up communications with General Maude's column, which had entered the valley from the Ali Musjid side and the lower part of the Khyber.

Archibald Forbes, the *Daily News* correspondent, had come into the Bazar Valley with the Ali Musjid column, but he now quitted them, and rode over with us to join Tytler's force and to return with us by the Sisobi Pass to Dakka.

That forenoon the column blew up and burned the village towers and houses of the Bazar Valley, and by noon had quitted its bivouac, and turning its face towards Dakka began the long and difficult ascent that separates the Bazar Valley from the watershed of the Kabul river.

At first all seemed as if it was to be a mere walk over, but as usual in all Afghan, and perhaps in all mountain warfare, the mountaineer enemy, who never faced the column in the advance, followed it up in the retreat, and constantly fired on the rear guard.

A soldier of the 17th Foot was badly hit in the thigh, the bullet smashing the bone high up near the hip and inflicting an almost hopeless injury. Like all the English wounded, the man resented the injury most bitterly and vowed dreadful vengeance against the enemy.

The column bivouacked that night near the crest of the hills; the air was keen and biting and intensely electrical. The blankets placed over the wounded soldiers were a mass of crackling discharges of electricity.

The troops were sheltered in an oak forest, and the fires, the foliage, the starlit night, and the whole surroundings resembled rather a camp of brigands in the Apennines than the ordinary Afghan camping-ground amongst rock, and stone, and barren hill-sides steeped in the eternal khaki colour which pervades all Afghanistan.

No firing occurred after nightfall, and the troops sat round the fires in comfort while Archibald Forbes told stories of old times.

Next morning at dawn the column was again getting ready for the start for its long journey back to Dakka. The writer had been to the General to make a report about the wounded, when, while speaking to him, a shot, not a rifle shot, was fired close by the spot where we were standing, so close, indeed, that we thought some one was blazing at the wood pigeons who were flying about the trees close by, and the first thought was how foolish to alarm the camp by doing so.

The shot came, however, from quite another source, and in a few minutes the troops, who had been some time ready to move, began their march.

At about 8 o'clock a.m. began one of the most difficult, rugged, and dangerous descents through a series of the narrowest defiles ever seen either in Afghanistan, or, indeed, in any part of the Himalayas.

The column seemed to be for hours descending the rugged bed of a mountain torrent filled with huge boulders and so narrow as to compel all movements to be in single file. The snow lay in the deep recesses of the defiles, but the air was clear, and the sun shone with that absolute brilliancy which it does in the perfect Khyber atmosphere.

The moment the column began to move the hidden mountaineers commenced a musketry fire from every part of the hills.

It seemed exactly like the scene in the "Lady of the Lake," where Roderic calls up his clansmen by whistle. From amongst the pines, from out of the oak trees, from behind every boulder, came the unceasing dropping fire of the hillsmen. The General ordered each regiment to march as an escort over its own baggage, so that the column became for the time one very strong baggage guard; he himself remained with a strong rear-guard holding every ridge and vantage ground, while the main body hastened along the tangled path that formed our only road.

The way the tribesmen kept cover was perfect. I took the greatest trouble with the naked eye and with glasses to search the hill-sides, but saw not one of the enemy. All that was to be seen was the puff of the jezail, and now and then was heard the crack of the muzzle-loading Enfield rifle. Smoke there was in plenty and close by, but never a man was seen, and had the enemy been well-armed they could have done us much injury.

All through the hours the column continued this most exhausting retirement, continually followed by the enemy, losing men as we moved along, and the General himself holding the rear in person, aided by his staff, but not a man was seen to fire at.

During the retirement the unfortunate soldier of the 17th Foot, who had been shot in the thigh the previous evening, and who was being carried down the defiles in a red-covered doolie, came finally to grief.

The red cover of the doolie made an excellent mark for the jezailchis, and the unfortunate soldier was killed in his doolie by a bullet through his liver.

Another soldier of the same regiment was struck down by a bullet which smashed his thigh-bone. The writer was behind with the rear guard, while the man was to the front nearer Dakka. Archibald Forbes saw him fall and dressed his wound, leaving him in the track with a note pinned on to his tunic. He had done all that was possible for the soldier, and the writer coming on later with the doolies, picked up the man, and preserved the note as a memento of the day.

Some technical difficulty as regards the status of Mr. Forbes with the army prevented this act of his being recognized by the State, but there is no doubt he too earned the medal that day. The experiences of that day, even to an old soldier like Archibald Forbes, were, he himself said, perfectly novel, and he did not remember a nastier day.

The column got out of the entanglement of the passes and defiles by 1 o'clock p.m., but from 8 o'clock in the morning till 1 o'clock in the afternoon it was continually under fire, and the fatigue was excessive.

The sepoys took their wounds well, with the greatest sangfroid and bravery, and never resented the injury in the personal way the Englishman did, whose first cry was for revenge on the man who hit him, while the sepoy called for cheers for the sirkar.

The column continued its march all that day and did not reach Dakka fort until midnight. The long march and the shocks of the descent told badly on the wounded, and; the man dressed by Archibald Forbes did not survive the operation for his relief.

It is highly interesting to note the result of this expedition for a few days without tents on the Khyber hills.

The 17th were a singularly fit regiment, and for several days after their return did excellently well, but when the excitement passed off, the wear and tear and the exposure to the biting cold began to tell, and thirty-one cases of pneumonia resulted, with eleven deaths.

This was amongst the Europeans only. Pneumonia is the one dread enemy to be feared on these Afghan hills and table-lands. It

tells with fearful effect on the badly clad, underfed, and little cared for follower, to a large extent upon the sepoy, and to a considerable amount on the European soldier, although the latter is well fed and, as a rule, well clad. The way the followers died of it was most shocking. A grass-cutter in his flimsy dress would come in at three or four in the evening with his load, and seem fit and well. The icy night wind would strike him, and in three or four hours he would be dead with inflammation of the lungs. Men who came from malarious stations like Peshawar and Mian Mir at once fell victims, and it seems true that malarial fever so diminishes the vital energy of a man that he succumbs easily to lung inflammation in these mountain climates. One would imagine at first sight that sufficient care had not been taken to send the man to hospital, but it was soon evident that the onset was so rapid as to leave no time whatever for the man to sicken in the ordinary way.

It is impossible to dwell too much on the physique of the follower, the most careful inspection of all such men is essential before a war begins. Hundreds of men entered the Khyber who were hopelessly and completely unfit for even a hard day's work in the plains.

Their physical inspection on recruitment must have been perfunctory in the last degree. Weedy grass-cutters, cook-boys of the lowest bazar scum, doolie bearers who could not lift a basket let alone a doolie, officers' servants of poor physique, all such men are out of place in an Afghan field force. Two men reached the camp at Gandamak in the second campaign as hospital servants, toothless, decrepit, seventy years of age at least, and completely unfit for any work of any kind. They had been footballed up the Khyber from post to post, a game of sending the fool further, and eventually they drifted into Gandamak simply dying. The two old gentlemen were put to bed, and they returned to India by the next convoy, requiring twelve kahars to carry them, camels for the kahars' kit, food for the camels, &c., until in the end their progress up and down the Khyber probably cost hundreds of rupees, and for what? How and why did they enter the Khyber at all? When next the army enters these passes to fight there should be at Landi Kotal, or Dakka, as also at the Kojak, a rigid physical examining post, and there let a medical officer, with the feelings and ideas of a *soldier-surgeon,* ruthlessly fling aside every follower not up to a good physical standard of fitness and health. This may do much for the army, but there is a higher law still, which would say, abolish the follower altogether.

If the British regimental cook-boy is of poor physique, abolish him, and let the soldier learn to cook and fight also. Six years later than the Afghan War, the writer was for one month in camp at Tambook, on the Suakim-Berber road, with the Scots Guards in the Sudan. These men, fresh from Chelsea or St. George's Barracks, had neither bheestie, nor sweeper, nor cook-boy, and they were wonderfully fit under a sun beside which the Afghan sun is as nothing, and did all their own work and fatigue. The same, too, must be done in India, as regiments fresh from England are doing in climates similar to India, and on the Afghan table-land the English soldier can easily do everything for himself.

Officers' native servants should be dressed like their masters' regiments, and should wear on their shoulder straps the badge or distinctive mark of the corps. They should have a field kit like a soldier, a haversack, water-bottle, and a sword-bayonet, or other defensive weapon carried in a waist belt.

In the sepoy battalions it is difficult to see the need of any followers whatever. Water-supply should be done by armed soldiers leading puckal mules, and the company sweepers should be the battalion pioneers dressed, drilled, and equipped like the pioneers of British battalions.

These men, meat eaters, with no scruples as to what rations they get, survive better under pneumonia than the vegetable feeders, for pneumonia is the real *Hindu Kush*, or Hindu killer, of Afghanistan.

Officers of the native corps should supply themselves with servants in full from their battalions, letting their cooks be Mussulmans, and their syces of the same type as the mountain battery drivers, the only model of a syce we want in the army.

The whole of the permanent hospital corps should be drilled, armed, and organized as sepoys, and there is no difficulty whatever in doing this, and so making the army readier for war.

That frightful mass of people, the commissariat native establishments, without uniform, without drill, without discipline, should also be dealt with, and at any rate put into the distinctive uniform of their department. Once in uniform one has an enormous hold over the individual, and the marauder lurking behind the crags of Afghanistan thinks twice before he descends to attack a man in uniform with a sword, even though that man may be but a commissariat gomashta tumbling over his sword at every step.

By such gradual action we may diminish the mass of followers

in the army, and develop its military efficiency and mobility in every way.

On the return of the column to Dakka from the Bazar Valley, the head-quarters of the field hospital was found to be on the march up from Ali Musjid to Jalalabad, and was halting at Dakka for the day. It moved on the morrow to join the head-quarters of the division at Jalalabad.

The winter passed over at Dakka with continual work for the doctors, and it was not until one day in March that we suddenly remembered that we had been more than four months in the field.

The unceasing cares of a big hospital, convoys arriving from the front, convoys leaving for the base, and the care of the post itself, all kept one fully employed.

In the hospital one was continually confronted by the unreadiness of the medical service for war. The transport was very defective. The need of a good *kajáwa* for use with camels, a most important aid in war, was much felt, and the want still exists. If such an equipment could be found, it would carry a sick man and his kit, and be of the greatest use for evacuation of milder cases. A kind of chair for mules to carry one sick man riding across the mule would be a great boon, with supports on the saddle to prevent a weakly man from falling off.

Quick-moving horsed ambulances, which could cover easily two of the ordinary marches in a day, would in the end economize forage and more rapidly move the sick towards the base. Good bullocks are so expensive, and at the same time move so slowly, that their use in ambulance transport on the communications is certainly questionable. Hospital drugs, too, were in those days awfully unportable, too numerous, and loosely packed in big bottles, as in a chemist's shop. One carried quinine to Kabul over the Lataband Pass, 8,000 ft. high, as loosely packed in big glass bottles as it could be in Savory and Moore's stores in Bond Street.

The compressed drugs now so general were then unissued, and the medical store depôt was at Mian Mir, cut off by a long road from even Peshawar. It was impossible to get up medical stores.

Officers at Dakka had written home to England and got out supplies to Dakka before one could get drugs, even those from Peshawar. The medical service wanted then, as it wants always, to copy army systems and army methods, and the quinine should no

more have gone up loose to the front than powder goes up loose in barrels to regiments in the field. Medical cartridges of pills and drugs, and compressed medicines, are quite as possible as gunpowder cartridges, and few drugs are needed in the field.

A medical officer at Jagdalak was heard to complain that he could not get a rare and difficult-to-be-obtained drug for the treatment of some ailment; but it is impossible in war to meet the varying demands of various medical officers, and that man is the best army surgeon who can utilize as far as possible the ordinary supplies found with the column, and limits himself to some twenty potent medicines small in bulk but active in property. Rum should largely take the place of brandy, and poultices be made of some forage supply. To-day the medical service is far better off than we were even ten years ago in these respects. But the lesson of the army methods and the army systems is still open to be read by him who has the power to read it. The more one diverges from these principles the more one goes astray.

The doctors felt most markedly in the hospitals the want of European soldier orderlies to care for and nurse the bad cases. Situated as the British army is in India, surrounded by a race so different in customs, traditions, and ideas of comfort, it cannot draw upon them for nursing care in sickness. It is the custom in peace time in India to draw sick attendants from the European battalions in cantonments to nurse their sick comrades, and the orderlies so employed return to their battalions when their nursing labours terminate either by the recovery or the death of their patient. It is a makeshift system, but still it works. But in war, when the cases are infinitely worse, require far more care, and the doctors are unable to supervise as fully as they would do in peace, they have no such men at all given them, and the sick man is left entirely in native hands.

The want is dreadful, and irreparable in every way.

The native establishment is fit only for fatigues, and not for nursing. The medical department wanted then, and it still wants, and in any future campaign it most certainly will want, a percentage of European soldiers to care for the bad cases in field and general hospitals.

Probably twelve such men would be needed for every field hospital of 100 beds; the apothecary class do not fulfil these duties, and it is essential for the army now in peace time to prepare for war, and train these men for field work. The medical department should act just as the Indian commissariat and ordnance department

do, and draw from the battalions a certain number of men on probation. Let them see hospital work, and, if approved of, be transferred to the unattached list, and be posted to the medical department for duty, with the power of remanding them to their battalions for misconduct. The chief who accomplishes this will have made success in war still more possible for the medical service and the army, and he will certainly save the lives of his medical officers, who constantly die in campaigns from overwork of a kind that could easily be done by subordinates. It is perfectly impossible to work the field hospitals efficiently without them, and any opinion to the contrary cannot be based on a true peace or war experience.

The nursing classes lately introduced by order of His Excellency Sir Frederick Roberts, the present Commander-in-Chief, are paving the way for the final development of the main idea, but until that final development comes, and the men are given in peace for war and for permanent duty, failure in hospital efficiency in the field must be inevitable. It is better to have clear conceptions on this head now than to have commissions of inquiry afterwards, when failures have occurred and deaths which might have been prevented have taken place. For it is ever to be remembered that in any such inquiry the real sufferers give no evidence. They are at rest for ever from all such worry, and the most telling evidence is not forthcoming nor ever can be. It lies quiet in the grave.

The then Commander-in-Chief in India, Sir Frederick Haines, came through Dakka *en route* to Jalalabad in February, 1879, and Surgeon-General Ker-Innes was with him.

(*To be continued.*)

Reviews.

AIDS TO TROPICAL HYGIENE. London: Baillière, Tindall and Cox, 1912. Pp. vii and 187. Price 2s. 6d. Cloth 3s. net.

This little book is an additional proof if such were needed of the literary fecundity of the author. It contains a large amount of information, carefully collected, succinctly, and in great part accurately stated. The reason for its publication is given in the preface, that the subject of "Tropical Hygiene has hitherto been much neglected." This statement can hardly be accepted if it is intended to refer to books of a class likely to appeal to educated scientific men, especially those acquainted with the German language. Unfortunately it is true enough as regards such publications as might be useful to non-medical officials, military or civil, or to explorers, or engineers engaged on large works in tropical countries. The present work goes rather too much into details of a purely scientific nature for readers of the class just referred to, as for instance in the long account of the sexual cycle in the malarial plasmodium. On the other hand the statement on p. 18 that "the average adult gives off about half a cubic foot of carbon dioxide per hour" though not extraordinarily accurate is still sufficiently close to the mark for a non-scientific reader. The student who wishes to know exactly how much carbon dioxide is given off for purposes of accurate calculation (or in an examination) might be somewhat misled. The remarks on p. 52 as to the storage of protein are rather misleading. The body cannot be said to store protein in the way that it stores carbohydrates or fat. In the ordinary healthy man the intake and output of nitrogen balance each other almost exactly if any period of more than a few days be taken. Any sudden increase in intake is, it is true, not immediately met by a corresponding increase in output, but in a very few days equilibrium is again established. In convalescence after a wasting disease, or when there is a sudden demand for muscular work coincidently with an increased supply of nitrogenous food, then indeed protein may be laid on, but not otherwise. The author appears by the way to use the spellings "protein" and "proteid" indifferently. There is occasionally a trifling inaccuracy of a kind easily detected by a scientific reader but apt to be annoying and misleading to a non-scientific one. Thus in the Table in Appendix I the mode of infection in the case of dysentery and paratyphoid is described by the words "as enteric." In the column of diseases however enteric fever does not appear, typhoid fever only being referred to. The lay mind very frequently does not recognize the absolute identity of the two terms.

In the index there is a heading "Cholera Belt," but no other reference to the not unimportant disease cholera; plague, dysentery, enteric fever, beri-beri and heat stroke share an equal obscurity. It is true that some of these are referred to in a Table in the Appendix, but the last three on the list do not appear even there. It can hardly be urged that pellagra and tuberculosis, which do appear in that Table, are of equal importance from the point of view of tropical hygiene as the

three important diseases just named. The section on insects and animal parasites is very full, but no such partial concentration can excuse omissions such as have just been referred to.

C. H. M.

FIFTY DOCTORS AGAINST ALCOHOL. London: The Brotherhood Publishing House, Holborn Hall, 1912. Pp. 282. Price 10s. 6d.

Bishop Blougram in his immortal "Apologia" points out how comparatively little interest attaches to the opinions on a debatable subject of those whose minds are long known to have been made up definitely in one direction or another. Accordingly when one reads the list of authors of the publication under notice it is impossible to feel a certain lack of curiosity as to the facts brought forward in support of their views against alcohol. Whether it was worth while or necessary to bring such heavy artillery to bear against a long ago abandoned position seems doubtful. No man at the present day holds drunkenness to be otherwise than bad, morally, intellectually and physically. The majority of people on the other hand hold, and back their opinion by practice, that for reasonable men moderate drinking is certainly not injurious, and occasionally beneficial. Such people are hardly likely to be converted from their habit by being told (p. 12) that "alcohol is an acrid narcotic poison." The prompt reply would be "alcohol may be, but that personally I do not drink it; I prefer wine or beer." Dr. Brown (p. 20), discussing whether alcohol is or is not a stimulant, says "a stimulant is the poker wherewith we stir the fire. Perhaps what the fire really needs is more coal putting on, but still it responds to the stimulation of the poker and blazes up brightly." No other simile could be more appropriate an illustration of one at least of the conditions under which the stimulant action of alcohol can be advantageously used in military practice. There are many occasions when an additional supply of coal, without the stimulus of the poker, will merely choke out a dying fire, and there are not wanting occasions on service when a tired man will not face his evening meal unless he is stimulated by a tot of rum. On p. 127 Sir Victor Horsley, referring to the phrase used by King George when Prince of Wales, "Wake up England," says "The medical response to this kingly advice is: Abolish the drink trade." Does Sir Victor really expect this statement to be accepted as a real fact? The present reviewer is under the impression, not unfounded on experience of more than one extremely pleasant dinner given by some learned medical corporation or other, that the practice of a large number of medical men is by no means consonant with a complete stoppage of the wine trade, or even that in the humbler spirits. A statement made by Mr. Horace Rose, Surgeon in Ordinary to the Royal Bucks Hospital, Aylesbury, on p. 219, is sufficiently remarkable to warrant repetition, it runs as follows: "The reason more doctors are not openly for abstinence is that it does not pay. The power behind the drink traffic is so great and so far-reaching in its ramifications, socially and politically, and so vast in its wealth, that *most medical men* dare not speak out boldly in favour of total abstinence" (the italics are not Dr. Rose's). *Most* medical men! A great lawyer and statesman once declared his inability to draw up a bill of indictment against a nation. Mr. Rose does not apparently find any difficulty in indicting a great profession. It would be interesting to hear

him substantiate his statement before an impartial audience, by production of names and dates. In such a good cause malice could hardly be suggested.

In conclusion, every sane man knows that drunkenness is folly, and that it is at the root of half the crime, and probably half the poverty of the country. What the average man does not know, but as to which he is quite prepared to listen to unbiassed evidence, is whether the glass of beer or wine, or spirits and water that he drinks in a reasonable manner at his meals, or after the day's work is done, makes him in any sense of the word a worse citizen than the total abstainer. He is strongly, I imagine, of opinion that it does not, and it does not seem probable that the mass of loose statements and lax logic of which this book mainly consists will cause him to alter his verdict. In the meantime there are two quotations from the two greatest books in our literature, which he will probably consider as of more real value. The first is, "Wine that maketh glad the heart of man," and the second, "Dost thou think because thou art virtuous there shall be no more cakes and ale?"

C. H. M.

Military Law Made Easy. By Lieutenant-Colonel S. T. Banning. Aldershot: Gale and Polden, Ltd., 1912. Sixth Edition. Pp. xiv and 329. Price 4s. 6d. net.

The usefulness of this book is well known and undoubted. Its perusal will give the beginner a good and useful idea of the subject of military law.

Those preparing for examination can obtain excellent practice by working out the answers to the questions in the Examination Papers given at the end of the book, and comparing them with those given by Lieutenant-Colonel Banning.

In this edition the work has been brought up to date.

P. D.

A Treatise on Hygiene and Public Health with Special Reference to the Tropics. By B. N. Ghosh, L.M.S. (Cal. Univ.), and J. L. Das, L.M.S. (Cal. Univ.). Calcutta: 1912, Hilton and Co. Pp. xix and 378. Price Rs. 3.8 or 5s. net.

In the small compass of this book an attempt has been made to cover the whole ground of public health, with the exception of sanitary law. The subject is therefore necessarily very much curtailed, more especially as much of the text has special reference to the Tropics. An introduction by Colonel Kenneth Macleod traces, in his usual elegant style, the history of sanitation down to the present time.

The subjects dealt with are those usually found in any text-book on hygiene, but additional interest is supplied in the description of methods, appliances and circumstances peculiar to the sanitation of native communities in civil life in India. From this point of view the book supplies a distinct want, and will be found of great benefit to native students in India. As a general text-book of hygiene, however, the many gross inaccuracies in the text and a certain crudeness of expression will militate against its use by British students.

The chapters dealing with food and diet are excellent, and a sound knowledge of the latest theories on these subjects may be obtained by

their perusal. The chemical and bacteriological examinations of water which are dealt with in three pages and nine lines respectively had better have been left out altogether, as these do not enhance the value of the book. The parts of the text dealing with the peculiarities of Indian sanitation and Indian foodstuffs may be found of use to the sanitary officer in India, and in this the whole value of the book lies, at any rate as far as officers of the R.A.M.C. are concerned.

H. B. F.

VACCINE THERAPY; ITS THEORY AND PRACTICE. By R. W. Allen, M.D., B.S.Lond. Fourth Edition. London: H. K. Lewis, 1912. Price 9s. Pp. x and 444.

The use of vaccines has become so well established as an additional resource in the treatment of disease that there are few pathologists now who are not frequently called upon to assist their colleagues by preparing the necessary vaccine. Frequently also it happens that the pathologist has not had any experience in the administration of vaccine prepared from the particular bacteria concerned. He requires some guidance if he is not to waste time experimenting, and there is no work to which he can more profitably turn in his difficulty than this.

In the first two chapters are given a general account of antibodies and a critical survey of the use to which an estimate of each of these can be put in diagnosis, prognosis, and as a guide to treatment. Here we note that the author considers the opsonic index useful in diagnosis and in determining whether a patient is cured of a given infection or not, but that as a guide to treatment it is, on the whole, unsatisfactory and unpractical. For this he would rely as a routine measure rather on clinical effects, and resort to the index determination only in cases of exceptional difficulty.

The third chapter is devoted to the preparation of vaccines and their administration, and provides many useful details on collection of material for cultivation and determination of the infecting bacteria. Regarding dosage, the author emphatically thinks, and this opinion is constantly repeated throughout the book, that vaccines often fail because they are given in doses which are too small; he holds that there is too great a tendency to "play for safety and not to win." Here he is in conflict with numerous workers who employ considerably smaller doses and claim as good results. For example, Eyre, whom the author quotes in support of his contention that gonococcal vaccine is good for acute gonorrhœa, recommends extreme caution, especially about the initial dosage, and would give only from 500,000 to 1,000,000 gonococci, while the author expresses some contempt for such small doses in the phrase "Begin if you will with 5,000,000, but . . ." We cannot help thinking that the reconciliation of such opposite teaching lies in the source of and method of killing the vaccine employed by each school. We think that this subject might profitably be discussed in a work of this nature.

The remainder of the book deals with the application of vaccine therapy to diseases of different parts of the body. The arrangement of this section is excellent. Commencing with a list of the diseases to which each structure is liable and the bacteria concerned, each is then discussed in detail, so that reference is wonderfully easy. A valuable feature of the subsection dealing with the vaccine treatment of each disease is a

paragraph headed "Preliminary considerations," in which the reader is reminded of the other things he can do to assist Nature to overcome the invader besides injecting the vaccine, folding his hands and hoping for the best.

We think that pathologists will find this work a most useful addition to their libraries.

L. W. H.

SURGERY FOR DENTAL AND JUNIOR MEDICAL STUDENTS. By A. S. Underwood, M.R.C.S.Eng. London: J. Bale, Sons and Danielsson, Ltd., 1912. Pp. viii and 244. Price 3s. 6d. net.

This little book appears well suited to the requirements of students studying for the L.D.S. and perhaps as an elementary manual for medical students. It is clearly written and expressed in phraseology easy to understand. Some of the descriptions of surgical treatment are very good indeed, but it is to be regretted that students should be led to believe that perchloride of mercury is the most usual form of mercury used in intramuscular injection for syphilis. The following passage occurs on p. 95: "This method causes considerable pain and irritation, and does not appear to possess any great advantages. Various salts are used, the perchloride being perhaps the most usual. Metallic mercury is also used."

If the perchloride were the most usual treatment, the words "pain and irritation" would probably be correct.

B. W. L.

Current Literature.

Growth of Tissues "in vitro."—In the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for August, 1912, p. 261, reference was made to Carrel's wonderful experiments on multiplication of cells apart from the animal body. In the *Journal of Experimental Medicine* for January, 1913, p. 14, he shows that extracts of tissues and tissue juices can accelerate the growth *in vitro* of connective tissue, sometimes as much as forty times. This power was most marked in extracts of embryos, of spleen, and of Rous's sarcoma. The property was removed by heating the extract to 70° C., or by passage through a Chamberland filter.

Carrel states that if the rate of the reparation of tissues were activated ten times only, a cutaneous wound would heal in less than twenty-four hours, and a fracture of the leg would be cured in four or five days. On the date of issue of the number of the Journal in New York this paragraph without the conditional clause was cabled to England, with the result that readers were startled by the announcement that Carrel had cured operation wounds in twenty-four hours, and fractured bones in four days. In this paper, however, he is guarded in his statements, and says: "Possibly the finding of the activating power of tissue extracts will have no immediate practical application. Nevertheless, it may be indirectly useful by leading to the discovery of some of the factors

determining the growth of tissues, and of the unknown laws of cell dynamics, and may ultimately throw light on the mechanism of the cicatrization of wounds."

Foot (*loc. cit.*, p. 43) grew fragments of chicken's bone-marrow, which had been teazed out in Locke's solution, in drops of blood plasma on cover slips in hanging-drop preparations by incubating at 40° C. for periods of four hours to six days. After fixing in 10 per cent formalin, they were stained by Weigert's iron-hæmatoxylin and eosin, or by Giemsa's method. In tracing the development of the polynuclear leucocyte from the lymphocyte he found that the nucleus, which is at first round, becomes indented and kidney-shaped, its two halves being finally connected with each other only by the merest strands in which small nodular enlargements sometimes are seen. The next step is the tearing through of the interlobular filaments. The process is repeated until one cell often contains several nuclei. In small polymorphonuclear forms on the third or fourth day of growth degeneration becomes apparent. The karyosomes of the nucleus become rod-shaped, occasionally forming skein-like figures; or the cells extrude one nuclear lobule in a pseudopodium of cytoplasm, the connecting filament of chromatin breaks through, the pseudopodium is cast off, and a small lymphoid cell that has a pyknotic nucleus results. Similar observations have been made by numerous authors, including Weidenreich.

This study is of great importance at the present time, for there have appeared recently in the English Medical Press several communications on "Intracellular Parasites of Syphilis." Many of the figures which accompany these papers would likewise serve to depict the nuclear and cellular changes which are indicated above.

C. B.

Living Vaccines.—Castellani (*Trans. Soc. Trop. Med.*, January, 1913, p. 57) inoculates tubes containing 10 c.c. of broth with two loopfuls of a forty-eight-hours-old culture of a non-virulent typhoid strain which has been growing in the Ceylon laboratory for years. After twenty-four hours' incubation at 35° C., they are heated to 50° C. for one hour. Ten minims are injected beneath the skin of the arm, and a second dose of twice the quantity is given a week later. The inoculation is followed by a local and general reaction, which is more marked than that produced by dead vaccines; the fever does not last longer than twenty-four or thirty-six hours, and does not incapacitate from work in most cases.

The total number of people inoculated is more than 2,000, but the after-history of all is not available. Four cases of enteric occurred in 250 persons who had received two doses of dead vaccine; one attack was reported in 294 people who had had two inoculations with living cultures; and one case was noted in 260 persons whose first inoculation was with dead vaccine, and the second with living. All the enteric attacks ended in recovery. The living attenuated vaccine is harmless. Professor Browning, the Director of the Ceylon Chemical Laboratory, has had fifty-three inoculations in the course of eighteen months. He has remained in perfect health, although each of twenty-four of the later injections consisted of 2 c.c. of mixed living typhoid, paratyphoid A and paratyphoid B cultures.

Castellani has used peptone water cultures of Shiga's and other dysentery bacilli after heating them to 50° C. Broth growths cause a painful swelling at the site of injection.

When he employs mixed vaccines he gives 300,000 million typhoid, and 150,000 million each of paratyphoid A and B. A week later a double dose is injected, which is repeated in seven days time. He refers to the good results reported by Metchnikoff and Besredka, which were obtained with sensitized living cultures; chimpanzees can only be rendered immune to the *Bacillus typhosus* by means of living vaccine. Alcock's experience is also favourable.

C. J. Martin (*loc. cit.*, p. 69) found that, in the case of an old laboratory culture of *B. typhosus* preserved at a low temperature, the majority of the bacilli were killed in a 24-hour-old broth culture by heating at 50° C. for one hour; when, however, he used an old culture which had been kept constantly in the 37° C. chamber, the number of living bacteria was nearly the same at the beginning as at the end of the hour's heating to 50° C. Starting with 600 per c.c. they increased to 3,000 per c.c. in thirty minutes, but fell to 400 per c.c. in sixty minutes.

It is not sufficiently realized how greatly the death point of the *B. typhosus* is influenced by small variation of conditions. One strain differs from another in this respect. The minutest change in the reaction causes profound alterations in the death-rate. The temperature co-efficient is 1·6 per degree, which means that, on raising the temperature of heating two degrees, they are killed two and a half times as quickly; and ten degrees, three hundred times as quickly.

C. B.

Cultivation of Malarial Parasites.—J. G. Thomson and S. W. McLellan (*Annals of Trop. Med. and Parasit.*, December, 1912, p. 449) withdrew 8 c.c. of blood from the median basilic vein of a man at the onset of an attack of malignant tertian ague, mixed it with $\frac{1}{10}$ c.c. of a 50 per cent solution of Merck's dextrose, defibrinated it by gently stirring with a glass rod and transferred it to culture tubes, in which the cells settled to the bottom, leaving a column of about half-an-inch of serum on their surface. After incubation at 38° C. for twelve hours, a few cells of the superficial layer of the red and white corpuscles were removed with a pipette and examined as smears fixed in methyl alcohol, and stained with Giemsa or Leishman's solution: the parasites had increased in size from 3μ to 6·5μ; a round mass of pigment about 1μ in diameter was present; the chromatin had increased and had become diffused in many cases. The infected corpuscles tended to clump together, as many as sixty were counted in one mass. After twenty-five hours' incubation at 38° C. segmenting forms were seen in large numbers in which from two to thirty merozoites were counted. A micro-photograph is given in which are seen hundreds of these schizonts massed together. The pigment was distinct and appeared encircled by the merozoites in many cases.

After twenty-seven hours' incubation at 38° the corpuscles had burst and the merozoites had escaped to be destroyed by the serum and leucocytes, for only few segmenting forms and merozoites could be seen.

After sixty-six hours at 38° scarcely any parasites could be discovered. Examinations made at a later period were negative.

Blood was abstracted from a second case of malignant tertian ague at the beginning of the pyrexia and was treated in a similar manner, but segmentation did not proceed so rapidly as in the former instance, nor did the nucleus break up into so many fragments. The patient had been taking quinine regularly before the onset and it is suggested that this had impaired the vitality of the parasite.

Sir Ronald Ross writes: "I have examined both the specimens sent to me by Dr. Bass (see JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, December, 1912, p. 781) from Tulane University, U.S.A., and those made by Drs. Thomson and McLellan in Liverpool, and am quite convinced that they give indisputable evidence of the successful cultivation of *Plasmodium falsiparum* up to sporulating forms. These forms are much too numerous in the specimens to admit of the supposition that the parasites have not developed since the blood was taken from the patient. The advance thus made is one of great importance, as all efforts to cultivate the parasites of malaria have hitherto failed since their discovery by Laveran in 1880."

JOUKOFF (*C. R. Soc. de Biol.*, January 24, 1913, p. 136) abstracted 10 c.c. of blood from a patient suffering from malignant tertian ague and divided it into four tubes, each containing half a cubic centigramme of a 10 per cent. sodium citrate solution, which he incubated at 41° C. for half an hour, and afterwards at 25° to 30° C. The first stages of the sexual cycle were evident in two hours, pear-shaped cökinets appeared which contained a central pigment mass when mature. The culture survived for three days.

He also investigated the blood of a case of quartan ague by the same method, except that he added 1½ to 2 c.c. of Locke's fluid to each 5 c.c. of citrated blood. He observed segmentation forms and merozoites in large numbers for six days.

C. B.

Inoculation with Attenuated Tubercle Cultures.—Marcus Rabinowitsch (*Berl. klin. Woch.*, January 20, 1913, p. 114) reduced the virulence of the tubercle bacillus by growing it in media which contained 0·1 to 0·5 parts per thousand of formalin. Two guinea-pigs which received subcutaneously 0·002 grm. of such a growth, dried for twenty-four hours at 37° C., were free from all signs of infection when they were killed five and six weeks later.

Six guinea-pigs were vaccinated with 0·002 grm. of this attenuated culture and in two months' time were inoculated with a similar dose of virulent human or bovine tubercle bacilli which caused fatal infections in control animals in five or six weeks. The protected animals increased in weight and showed no evidence of tubercular disease when they were killed after an interval of six weeks.

C. B.

Salvarsan and Yaws.—The *St. Lucia Gazette* of November 9, 1912, contains a special report on the treatment of yaws by salvarsan. Altogether 112 cases were treated. The average stay in hospital was twenty-seven days as against three months under the former plans of treatment. The drug was well tolerated by the coloured inhabitants; every patient over fourteen years of age received 0·6 grm. by intramuscular injection. In some of the earliest cases a much smaller dose was injected, but the results were disappointing. The injections were not followed

by necrosis or any other unpleasant complication. Large doses of perchloride of mercury were given after the injection. In about forty-eight hours the crusts on the skin began to dry up and the lesions rapidly healed over. On mucous surfaces healing took somewhat longer. The treatment was much appreciated by the native population.

C. E. P.

Antityphoid Vaccination.—The following extract is taken from the *Army and Navy Register*, November 9, 1912: "The army medical officers are much gratified with the continued success of the antityphoid vaccination, the records concerning which lately received by the Surgeon-General having surpassed the expectations of even the advocates of the measure of prevention. Among the 57,000 troops in the United States, for example, there have been during the last ten months but twelve cases of typhoid fever and only two deaths. Most of the cases were among recruits who had not received the treatment, and of the deaths, one was an officer and the other a recruit, neither of whom had been vaccinated against typhoid. Considering that some of the troops are in the field, serving under conditions which would in previous years produce typhoid at the rate of 150 cases and fifteen deaths in a corresponding period, the army surgeons feel that the enforcement of the system leaves no room for any question of the wisdom of that proceeding. The rate of typhoid per 1,000, beginning with 1906, is as follows: 1906, 5·66; 1907, 3·53; 1908, 2·94; 1909, 3·03; 1910, 2·32; 1911, ·80; 1912, ·18. These statistics are impressive and the remarkable reduction in typhoid is due entirely to the immunizing policy."

Tincture of Iodine for Blisters of the Feet.—Captain Richardson, Medical Corps, U.S.A. (*The Military Surgeon*, November, 1912), speaks highly of tincture of iodine when applied to blisters and abrasions of the feet. When the blister had not broken it was thoroughly painted with tincture of iodine and allowed to dry. The blister was then punctured at its margin and the fluid expressed, after which it was again painted with the tincture. When the blister had broken it was painted with the tincture and a zinc oxide plaster dressing applied. This was composed of several layers of plaster, the upper ones being in the form of rings so that pressure could not be exercised by the boot on the inflamed surface. The results were most satisfactory.

C. E. P.

Notes from the Turkish Army in Tripoli.—Dr. Theilhaber (*Berlin klin. Woch.*, No. 7, 1912) has written a short paper on his experiences at the Turkish headquarters, at Azaziah, during December, 1911.

Dr. Theilhaber went out privately as a volunteer surgeon to assist the Turkish wounded. He travelled via Zarzis in Tunisia and although he was provided with the necessary passports properly viséd by the French embassy in Berlin, he found considerable difficulty in obtaining permission from the French authorities to cross the frontier into Tripolitania.

The military hospital at Azaziah was in a deplorable condition. Patients lay crowded together on filthy mats, often without any blankets; the atmosphere in the wards was so bad that it made Theilhaber feel sick on entering them. He never saw a medical officer in the wards, and the

sick were expected to look after themselves. At midday and evening food was brought in large basins, the patients sat round these and ate out of them in common. Water of a dark colour, and containing much sand, was brought in a common drinking vessel which was passed from one to another in turn.

No reports or returns appeared to be kept; the Red Crescent Society made a note in pencil of the names of those men who were dressed by it. There were only seventy-five patients in hospital, and Kemil Bey, Chief of the Red Crescent Society, informed Dr. Theilhaber that up to the end of December the losses round Tripoli amounted to 100 killed and 400 wounded. No surgical operations were being performed and dressings and drugs were deficient. With the exception of those caused by shrapnel, the wounds healed up rapidly. Fortunately the Turkish army had very few sick. There was practically no medical organization with the Turkish forces. The Red Crescent Society had sent a small detachment, but only weeks after the outbreak of the war and the arrival of its *matériel* was still further delayed.

The only means of communication were by camel or horse along wretched tracks. No animal could be hired without permission of the local governor and then only on the payment of an exorbitant sum.

C. E. P.

The Bulgarian Army (Extract from the *Army and Navy Gazette*, January 25, 1913).—"The official list of killed and wounded in the war gives the following figures: Officers: Dead, 284; sick and wounded, 876; total, 1,160. Men: Dead, 21,018; sick and wounded, 51,000; total, 72,018; grand total, 73,178. It is stated that 70 per cent of the wounded have either recovered or are nearly well again. Many have rejoined their regiments. General Dimitreff, commanding the 3rd Army Corps, states that 35,000 of his men became infected with cholera at Tchataldja, but that only 3,000 died of the disease."

Balkan Campaign.—Medical Service of the Bulgarian Army. A. Hildebrandt (*Das Rote Kreuz*, No. 2, 1913). At the beginning of the campaign the medical service of the Bulgarian army was not perfectly organized; it was wanting in experience and had not fully realized the importance of hygienic precautions against disease. Later on, bacteriologists were obtained from other countries, and under their guidance energetic sanitary measures were carried out. Although almost every doctor in the country was called up for service the number was still much below the requirements of the army. Each infantry regiment of 4,000 men should have had one senior medical officer and one medical officer with each battalion; as a rule, however, there were only two medical officers in place of the four. At divisional headquarters there were as many as six medical officers including sanitary specialists, whose services were available wherever help was required.

The main dressing stations were established by the senior medical officers of regiments. To be out of range these had to be located at a distance of 2½ miles behind the firing line. Each company had one "feldsher" (dresser) and four stretcher-bearers. The position of the dressing stations was shifted to conform to the movements of the troops; the field hospitals which were located some 6 miles in rear of the fighting

line remained stationary. They were generally established in buildings and only when buildings were not available were tents made use of. The field hospitals had no beds and only a scanty hospital equipment; patients were accommodated on stretchers or on straw on the floor.

Each regiment was accompanied by one wagon for medical stores and each battalion by one ambulance wagon; the field hospital marched in rear of the division. On account of the bad roads, regiments were unable to use their heavy ambulance wagons and they were merely employed to transport sick from the railway stations to the base hospitals. Country wagons were employed with the troops for the transport of wounded; buffalo teams were found most satisfactory owing to their steadiness. The objections to ox wagons are that they cannot cover more than 10 miles in a day and that each cart can only take one severely wounded man.

At the beginning of the campaign an attempt was made to evacuate the severely wounded men as soon as possible in order to get them into the well-equipped base hospitals; so many died on the road that this plan had to be abandoned.

The supply service worked well and food was always obtainable in the field hospitals. Slightly wounded men received the same daily rations as the soldiers, viz., 1 kg. bread, 400 grm. of meat, 100 grm. of rice, beans or lentils or 200 grm. of potatoes, 50 grm. of dried plums, 50 grm. of butter or fat, 3 grm. of red pepper, 20 grm. of salt, 50 grm. of flour, 35 grm. of sugar. Alcohol was only issued on rare occasions; when the troops were exhausted a ration of 62 grm. (about 2½ oz.) of Schnapps (Hollands) was ordered.

The wounded were evacuated from field hospitals to stationary hospitals on the line of communication as quickly as possible; severely wounded were left in the latter till fit to proceed. The stationary hospitals were often five to six days' journey from the railway line. The fittings of the Bulgarian ambulance trains were somewhat primitive. The base hospitals in the larger cities were well equipped, thanks to the personal exertions of the Queen. Schools, clubs, &c., were taken over and fitted up as hospitals. The internal economy was managed by Bulgarians, while most of the medical work was carried out by foreign Red Cross personnel. Bulgarian ladies made excellent assistants to the trained Red Cross sisters. Convoys of wounded were timed to arrive during the night so that the populace should see as little of them as possible. As the lighting arrangements were usually bad, no surgical work could be undertaken till the following day.

Only a few of the troops had first field dressings, and those did not understand how to use them. Some regimental surgeons had purchased a French pattern of first field dressing for their units. Some of the wounded arrived at the dressing station holding the unopened first field dressing firmly on to the wound thinking that it was intended to be used as a compress to arrest hæmorrhage. Some regiments had been supplied with cotton bandages which the men carried loose in their pockets, so that when used they were in a soiled condition. Cavalry men carried a dressing in their wallets; when wounded the men were not able to get at their dressing. Many wounds were not dressed for several days.

The supply of splints was deficient; many cases of fracture had

to be transported long distances before the fracture was properly immobilized.

A good deal of faulty wound surgery was noted; dressings were in some cases too frequently changed, in others the wound had originally been plugged; about 40 per cent of all wounds suppurated; this unsatisfactory result was no doubt largely due to the long and uncomfortable transport to which the wounded were subjected.

On mobilization the men were fit and in hard condition, so that during the advance there was little sickness. When the army became stationary epidemics of dysentery and typhoid fever began. These were no doubt largely due to the drinking of unboiled water by the troops. Later on, cholera was imported by the Turkish prisoners and spread by the drivers of transport columns. Thanks to the work of the Viennese bacteriologists and strict isolation of infected persons the epidemic was speedily controlled.

The Bulgarian army surgeons worked hard and well, the real trouble was that there were not enough of them.

C. E. P.

Notes from a Field Hospital.—Dr. Bruno Busson (*Neues Wiener Tageblatt*, January 5, 1913) has contributed an account of his experiences at Tschorlu, from which the following notes are taken. He formed one of Professor Kraus's bacteriological mission to the Bulgarian army. The party travelled by train to Mustapha Pasha, and from there by motor through Karagatch, Semenli, Dimotika to Tschorlu. There were many cases of cholera, dysentery and typhoid among the Bulgarian troops. The King is stated to have issued an order directing every Bulgarian soldier to take an oath not to drink any unboiled water. In consequence the daily incidence of disease fell from 20,000 to 2,000. In Tschorlu there were roughly 2,700 sick and wounded accommodated in a newly-built Turkish cavalry barracks, including the stables. Most of the sick were lying on dirty straw; many of them were wounded, and all were covered with flies. All the patients were first bacteriologically examined, and those not found to be suffering from any infectious disease were transferred to the other hospitals.

The pointed steel-covered Turkish bullet appeared to be very humane and the wounds healed rapidly, as the pointed bullet did not force fragments of clothing into the wounds. Many of the wounded arrived without having been dressed.

Dr. Manolow, the Bulgarian medical officer in charge of the hospital, worked wonders in getting it into a sanitary condition. The piles of dung and litter, in which flies were breeding, were burnt, a risky proceeding, as quantities of ammunition had been hidden in it.

Although many children were seen in the streets with fresh small-pox eruption, not a single case occurred among the troops owing to their thorough vaccination.

The Bulgarians endeavoured to bury all dead men and animals; any carcass which had escaped burial was speedily disposed of by the troops of prowling dogs. The Bulgarians kept excellent order, and endeavoured to restore plundered property to its rightful owner.

C. E. P.

Balkan Campaign—Bullet Wounds.—Dr. Grinberger, Chief of the Swedish Red Cross Ambulance in Servia, has communicated the following notes:—

"In treating wounded Servians and Turks in the Swedish Hospital in Belgrade I have come across wounds from two different classes of rifle bullets: the Servian 7 mm. blunt-nosed bullet (like our Swedish 6·5 mm. ammunition) and the Turkish 7·65 mm. sharp-nosed bullet of German type. Both types, of course, are nickel-mantled. The action of both these modern types of projectile on the human body would, at first sight, seem to be the same, the one not less humane than the other, but on more careful inspection one finds that wounds caused by the sharp-nosed (Turkish) bullet are on the whole more favourable for speedy healing than those caused by the blunt-nosed (Servian) bullet, although the latter is of smaller calibre. Thus there are the cases of a Turk and a Servian, both wounded in the same bone of the forearm. They were hit just before a bayonet strife whilst advancing at the charge at a distance from each other of from 100 to 200 metres, at which ranges, as is well known, the modern blunt-nosed, nickel-mantled bullet causes a terrible smashing of the bone, as in the case of this Turk, whose arm was destroyed, whilst the Servian got off with a simple "Loch-Frakten," or a clean hole through his radial bone, without splintering. This is a sufficiently rare and fortunate case, but in connexion with all other similar cases is sufficient to stamp the sharp-nosed bullet as the more humane of the two. Further, the Servian was healed the quicker and soon fit for service again, whilst absolutely analogous cases amongst the Turkish wounded turned out much more unfavourably, with larger exit openings, and were more often infected (septic). The infection, of course, may be put down to want of early care and late application of the first dressing, &c. From a purely military point of view the Servians gained a great advantage by using a less humane type of bullet which made their enemies more unfit for service, and for a longer period, than the bullet to which they themselves were exposed."

Austrian Red Cross Society and the Balkan War.—A special number of *Das Rote Kreuz*, issued on November 25, 1912, contains a lengthy report of the assistance afforded by the Austrian Red Cross Society to the several belligerents in the Balkans. The following notes contain a short summary of this report.

Montenegro.—(1) A fully-equipped field hospital of fifty beds was despatched on October 23. The staff consisted of two army medical officers and one from the Reserve, all three being specialists in surgery, sixteen sick attendants belonging to the Army Medical Service, and four Red Cross Sisters. The medical officers and attendants were allowed full pay and field allowances from the Austrian Government; they also drew an extra allowance from the Austrian Red Cross Society. The officers and men wore their uniforms with Red Cross Society's badges.

(2) A fully-equipped field ambulance (corresponds to one section of a tent division of our field ambulance) was sent to Plavnica. The personnel, two medical officers and six sick attendants, belong to the Landwehr forces. The conditions of service were similar to those stated above.

Permission was also given to the Red Cross Society by the Minister for War to make use of the garrison hospital at Cattaro in case of urgent necessity. The Society is to make good any expenditure incurred on account of Montenegrin patients.

Oberstabsarzt Dr. Steiner was sent on ahead to arrange for the location and accommodation of both of these units.

Bulgaria.—As the Military Medical Organization of Bulgaria was considered to be fairly efficient it was decided only to send one fully-equipped field ambulance. The personnel consisted of two civil specialist surgeons and 2 army medical specialist surgeons with ten trained lady nurses. Subsequently seven other civil surgeons and one army medical officer joined this party. On arrival in Sofia most of the party took up duty in the military hospital there; two of the surgeons proceeded to a temporary hospital formed in Stara Zagora.

Servia.—A field ambulance party consisting of one army medical officer and one civil surgeon, together with ten sisters, was despatched to Belgrade on November 1. A large supply of surgical material and medical comforts was sent with it.

Turkey.—A large supply of dressings was sent to Janina on October 26. On October 27, a field ambulance unit, similar to that sent to Servia, was despatched to Salonika.

Greece.—A grant of £250 was sent to the Greek Red Cross Society.

Each of the detachments took a large supply of antitetanic serum.

A total of £7,500 was expended in fitting out these detachments.

C. E. P.

No. 4. April, 1913. Vol. XX.

Journal OF THE Royal Army Medical Corps

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A.M.C.
Toronto.

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ROYAL ARMY MEDICAL CORPS

ISSUED MONTHLY

IN ARDUIS FIDELIS

Printed and Published by
JOHN BALE, SONS & DANIELSSON, LTD.
OXFORD HOUSE,
83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W.

Price Two Shillings net.

Treponema Pallidum. Photographed on dark ground. Objective: Zeiss ½ in. (12mm.). Apochromat, N.A., 0·65. Eyepiece: Zeiss Compensating, × 27. Condenser: Watson Universal, Dry, N.A. 1·0, with central stop ·62 in. diam. Magnified 610 diameters.

To illustrate "Dark-ground Illumination in Microscopical Work."

By Maurice A. Ainslie, B.A., R.N.

VOLUME XX. APRIL, 1913. No. 4.

Journal of the Royal Army Medical Corps.

Original Communications.

DARK-GROUND ILLUMINATION IN MICROSCOPICAL WORK.

BY MAURICE A. AINSLIE, B.A., R.N.
Naval Instructor H.M.S. "Britannia."

1. HISTORICAL.

THE use of dark-ground illumination, by which is meant the illumination of an object in such a manner that the direct rays from the illuminant are not allowed to enter the objective (the field being consequently dark), is not by any means a novelty, though considerable attention has of late been attracted to it, especially for the purpose of exhibiting minute organisms, such as bacteria, in their living state, and a number of appliances have in the last few years been introduced for this special purpose.

In paper on "Dark Ground Illumination in Microscopical Work," by Maurice A. Ainslie, in April No. of JOURNAL OF ROYAL ARMY MEDICAL CORPS:—

Page 380, and elsewhere, the final letter of the name of Prof. Abbe should not be accented.

Page 383, line 1, after "constant" insert "in that particular medium."

Page 383, line 7, for "renewed" read "reversed."

Page 391, last line, for "latter" read "former."

Page 393, fig. 10, the outline of the paraboloid should follow the dotted line.

Page 394, line 2, for "firm" read "firms."

Page 394, line 17, for "revised" read "revived."

Page 389, line 28 }
Page 398, line 18 } for "stop" read "slip" or "slide."

Page 402, line 40, and elsewhere in the paper, for "heloscopic" read "holoscopic," and add inverted commas.

microscopes, and it has obtained a popularity to which its merits as an optical system certainly do not entitle it. Many years before Gillett, with his achromatic' condenser, had produced a more efficient instrument, which was provided, moreover, as the illustrations in the older books show, with a complete system of stops and diaphragms for dark-ground and oblique illumination, mounted in a rotating drum. This condenser appeared several years earlier than Powell and Lealand's achromatic condenser, introduced in 1854, which, though nineteen years before the Abbé, is much more efficient; and it is difficult to understand the neglect of this and other similar English appliances. Possibly the question of cost, and probably the fancied necessity for conforming, in medical work, to German ideas as to the best pattern of microscope; probably, too, the great advantage of an Abbé over *no condenser at all*, gave this illuminator a popularity which it hardly deserved, seeing that it was anything but an improvement on existing English models.

In many cases so-called "German" improvements were retrograde steps in comparison with what had already been done in England; and the progress of the microscope was probably more influenced for good by the English firm of Powell and Lealand, who, from about 1850 to 1880, stood almost alone in the excellence of their work, than by all the continental opticians put together. Powell and Lealand's No. 1 stand, designed in all its essential features as long ago as 1850, is still hardly surpassed in England, and is unequalled by any continental maker.

The Abbé condenser was soon completely outclassed by the achromatic condensers of Beck, Swift, Watson, and Baker, who, as well as Powell and Lealand, also produced *oil-immersion* condensers of great excellence, and all at a time when the continental firms clung persistently to the Abbé, and (until 1888, when Abbé produced his first achromatic condenser) made no effort to improve on it. Even at the present day the catalogues of Zeiss, Leitz, &c., while they do contain achromatic condensers of great excellence, seem to recommend the Abbé for visual work, the achromatic condenser being allotted to photo-micrography.

Since the condenser is at the present time the basis of the great majority of systems of dark-ground illumination, no apology need be made for outlining its past history. One or two other arrangements for dark-ground illumination remain to be mentioned, such as Wenham and Shadbolt's paraboloid and the spot lens. These will be described later, while the methods of Seidentopf

and Zigsmondy, for rendering ultra-microscopic particles visible, are, though strictly speaking a form of dark-ground illumination, outside the scope of this paper.

2. Optical Principles: Refractive Index and Numerical Aperture.

(*a*) *Refractive Index, or Index of Refraction.*—If a ray of light A O (fig. 1) travelling in air fall at O on the surface (whether plane or curved) of a dense medium, such as glass or water, its direction in the medium is not the same as its original direction in air. If

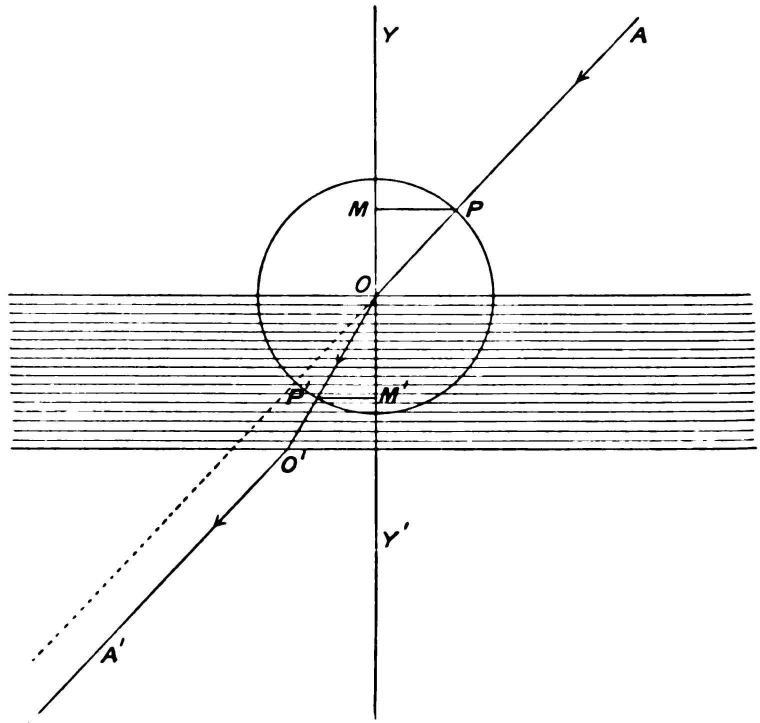


Fig. 1.

Y O Y¹ be perpendicular to the surface at O, and O O¹ be the path of the ray in the medium, the angle O¹ O Y¹ is always less than A O Y. Draw a circle about O, of any radius, cutting A O in P and O O¹ in P¹. Draw P M, P¹ M¹, perpendicular to Y O Y¹. Then P M is always greater than P¹ M¹ if the ray passes from air to a denser medium;

and the ratio of P M to $P^1 M^1$ is constant, and is called the refractive index of the medium. Evidently $\frac{P\,M}{P^1\,M^1} = \frac{P\,M}{O\,P} \div \frac{P^1\,M^1}{O\,P^1}$ since $O\,P = O\,P^1$; and these fractions are called the *sines* of the angles $P\,O\,Y$, $P^1\,O\,Y^1$; thus the refractive index of the medium $= \frac{\sin P\,O\,Y}{\sin P^1\,O\,Y^1}$, and is generally denoted (in England) by the Greek letter μ.[1] An inspection of fig. 1 will render a further point obvious. Any ray

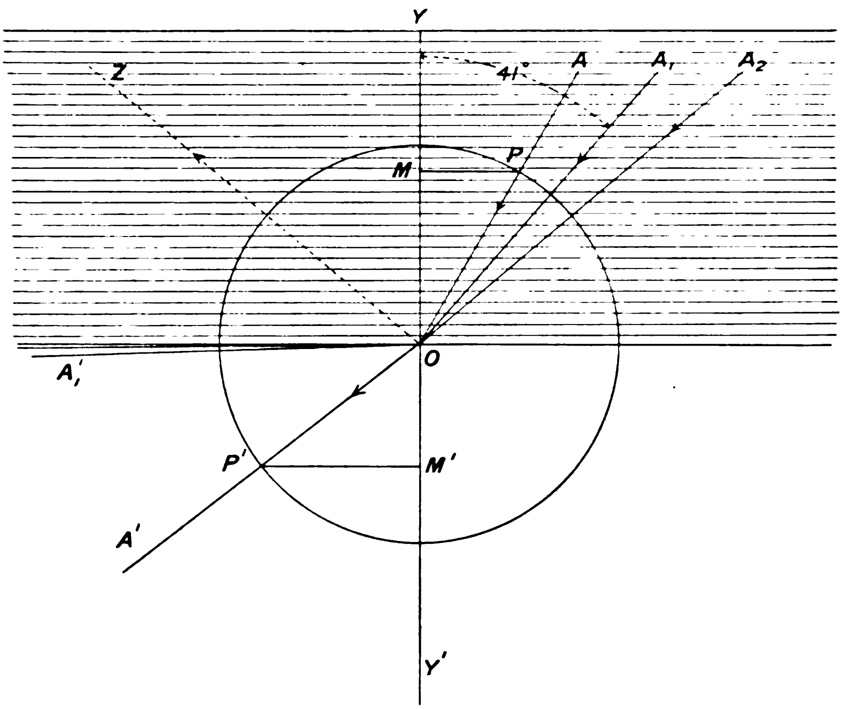


FIG. 2.

of light if renewed in direction will retrace its path; we can therefore reverse the process for an emergent ray; it follows that if the medium is bounded by a second surface, plane, and parallel to the first, the ray on emerging will be bent away from the perpendicular as much as it was bent towards it on entering; so that a ray of light is undeviated after passing through any medium bounded by plane parallel surfaces.

---

[1] This must not be confused with the μ which = 1 micron or ·001 mm.

Critical Angle.—This is of great importance in the theory of dark-ground illumination.

In fig. 2 suppose the ray A O to travel *in the medium*, and to fall on its bounding surface *from within* at O. According to the law of refraction just given, it will emerge in a direction O A^1 such that A^1 O Y^1 is greater than A O Y, and (construction as before) $\frac{P^1 M^1}{P M} = \mu$. Now let the obliquity A O Y of this ray gradually increase; P M will increase, and, in consequence, P^1 M^1, which bears a constant ratio μ to P M; and at some position A_1O it will be found that P^1 M^1 has become equal to O P^1, and of course can increase no further. What then becomes of a still more oblique ray A_2O? The answer is that it cannot emerge, but is reflected internally along O Z, which makes an angle Z O Y with O Y equal to A_2 O Y. This angle A_1 O Y (where the ray just becomes too oblique to emerge) is called the *critical angle* for the medium. Its value for crown glass is about 41°, for water about 48°. Generally, if θ be the critical angle, $\sin \theta = \frac{1}{\mu}$.

(*b*) *Numerical Aperture.*—This is a term introduced by Abbé to furnish a measure of the resolving and defining power of an objective. Before his time it had been known that these, as well as the brightness of the image, depended in some way upon the "angular aperture," i.e., the magnitude of the cone of rays which the objective was capable of receiving from the object.

But on the introduction of the water and oil-immersion objectives it was soon found that these, even if their angular aperture was no greater than that of the old dry lenses, were decidedly superior in resolving and illuminating power. For example, it was found that an oil-immersion of angular apertures 90° was considerably superior in resolving power to a dry lens of 120° (in fact, the numbers of lines per inch that can theoretically be seen with these lenses are as 104 to 83); it thus became evident that *angular* aperture was not the only thing concerned.

Going back to the wave-theory of light, and arguing by a rigorous mathematical process too long even to outline in the present paper, Abbé found that the resolving power of an objective was given by $\mu \sin \phi$, where ϕ is half the angular aperture and μ the refractive index of the medium (air, water, or oil) between the front lens of the objective and the object. In air $\mu = 1$ and the expression becomes $\sin \phi$. This expression he called the "Numerical Aperture," and it is commonly written "N. A." It is so important in the theory of the microscope, and

so frequently quoted in catalogues and marked on lenses, that it is very necessary to understand exactly what it means. Fig. 3 should make this clear. Here O is the objective, a b its front lens, P the object, A B the front lens of the condenser C, which is supposed to be concentrating on the object P, a cone whose angle equals the angular aperture of the objective. This angular aperture is aPb,

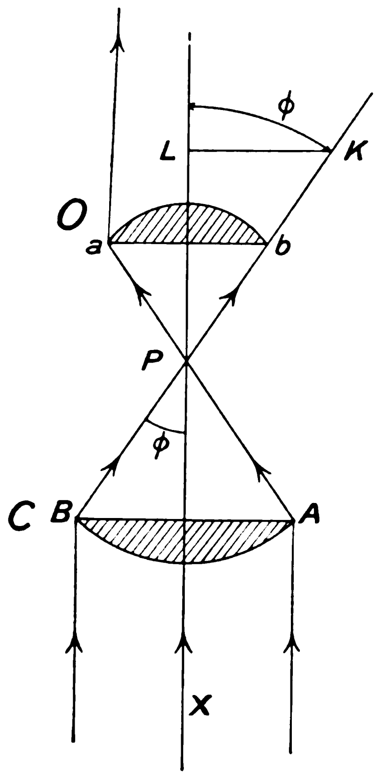


FIG. 3.

or A P B in the case of the condenser; but the *numerical aperture* or N. A. of the objective is the sine of B P X or K P L or ϕ, multiplied by μ, the refractive index of the medium (if any) between O and P ($\frac{KL}{PK}$ = the sine of ϕ). ϕ is the angle which the extreme ray of the cone makes with the axis; and for convenience we may also speak of the N. A. of a cone or a ray; thus the N. A. of the objective O, of the cone aPb or A P B and of the ray A Pa are all the same, and = μ sin ϕ or, in air, sin ϕ.

It is sometimes convenient to notice that the N. A. of an objective is very nearly equal to half the diameter of the back lens divided by the focal length of the objective. This is analogous to the rapidity of a photographic lens; in fact, the illuminating power of an objective or condenser is proportional to the square of its numerical aperture, or $(\text{N. A.})^2$.

The sine of an angle cannot exceed unity; so the greatest possible N. A. in air is 1·0; in a medium of refractive index μ, the greatest possible N. A., is μ. Thus a dry objective can theoretically have an N. A. of 1·0; a water-immersion of 1·33, and an oil-immersion of 1·52. Practically these values cannot be realized, as they would involve *angular* apertures of 180°; but dry lenses can be carried to N. A. ·95, water-immersion to 1·25, and oil-immersion to 1·4, these being the N. A. of the apochromatic objectives of Zeiss, Leitz, &c.

The N. A. of the $\frac{2}{3}$ in. objective generally met with is from ·25 to ·30; of the $\frac{1}{6}$ in., ·65 to ·8; and of the $\frac{1}{12}$ in., 1·2 to 1·3. The number of lines per inch that it is *theoretically* possible to see with an objective is found by multiplying the N. A. by twice the number of waves per inch of the light employed.

The mean number of waves per inch in white light is about 47,500; thus in white light a $\frac{1}{6}$ in. of N. A. ·95 should resolve ·95 × 95,000, or about 90,000 per inch as an extreme limit; an oil immersion of N. A. 1·3 should similarly show 95,000 × 1·3, or 114,000, more in fact than could be seen with any dry lens.

One important point in connection with numerical aperture remains to be noticed. If a ray of light is proceeding through a series of media bounded by parallel planes, such as are presented by the slip, cover, &c., in ordinary conditions, it maintains its N. A. constant; i.e., if at any point of its path it is travelling in a medium of refractive index μ, and its inclination to the common perpendicular to all the planes (the optical axis of the microscope) is ϕ, then its N. A., which is $\mu \sin \phi$, is unchanged. This does not mean that ϕ does not change, or that the ray remains undeviated; ϕ must change with μ to keep $\mu \sin \phi$ constant; and if at any point $\mu \sin \phi$ is greater than the μ (refractive index) of the next medium, the ray cannot proceed further, since that would involve a value of $\sin \phi$ greater than 1. (See "Critical Angle," above.)

The great importance of this is seen in the following fact: even if a ray of N. A. 1·4 can be produced by the condenser, it cannot get out of the condenser unless some medium of at least $\mu = 1·4$ is placed between condenser and slip; similarly, it cannot illuminate

any object unless the mounting medium has at least this refractive index. Thus, unless the condenser has a film of liquid between it and the slide, no ray whose N. A. exceeds 1·0 can pass from one to the other; if the object is mounted in a watery liquid (e.g., living bacteria) it is of no use attempting to pass a ray of more than N. A. 1·33 (μ for water); and finally, *unless there is some medium like water or oil between cover glass and objective, no ray of greater N. A. than* 1·0 *can pass out of the cover glass at all.* This is the central fact in connection with special dark-ground illumination recently introduced.

By the use of monobromide of naphthalin ($\mu = 1·67$) as immersion medium, Carl Zeiss has carried the N. A. of an apochromatic 2·5 mm. ($\frac{1}{10}$ in.) to the remarkable figure of 1·6; but this requires the front lenses of both objective and condenser to be of flint glass, as well as slip and cover glass, and the mounting medium must have at least this refractive index. No medium has been found of refractive index as great as 1·67 which does not destroy organic tissues, so that the use of the lens is confined to siliceous objects such as diatom valves. Its cost is not less than £40, but it probably represents the highest achievement (at present) in microscopical optics.

3. Description of the various Optical Systems employed for Dark-ground Illumination.

The conditions to be satisfied are as follows:—

(1) The condenser must have a considerably higher N. A. than the objective, at least 25 per cent greater; or the N. A. of the latter must be reduced to fulfil this condition.

(2) A stop must be used in conjunction with the condenser to cut out all rays of less N. A. than the objective. (This stop must, in fact, be rather larger than is here indicated.)

These conditions are shown diagrammatically in fig. 4, where the illuminating rays which fall on the object from the condenser, but do not directly enter the objective, are represented by dark lines; S (and S^1) is the stop; the cone B P A is dark; and the dotted lines in the cone aPb represent the light thrown off by the object, by which it is rendered visible.

N.B.—In all the figures which follow this lettering is preserved. C is the condenser, S the stop cutting out the direct rays from reaching the objective, P the object, O the objective, and the rays which illuminate the object are shown as dark lines, while those

that are "diffused" (diffracted, reflected, or refracted) by the object are shown dotted.

Condensing systems for dark-ground illumination are of three kinds :—

(*a*) Refracting, dry or immersed.
(*b*) Reflecting, dry or immersed.
(*c*) Refracting and reflecting.

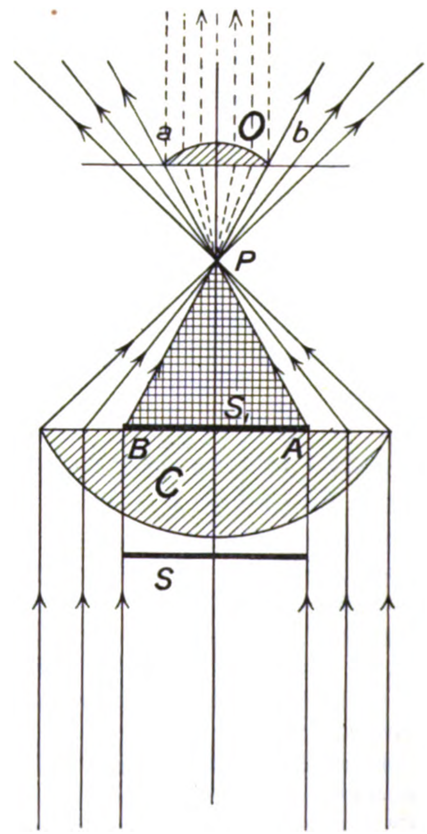


Fig. 4.

It may be as well to note here that a condenser is said to be used "immersed," or to be in "immersion contact" when there is a film of cedar oil or water, or other liquid, between its top surface and the under surface of the slip. Under these conditions it can theoretically, as has been shown in the last section, attain a N. A.

equal to the refractive index of the interposed liquids—1·52 in the case of oil, 1·33 for water, 1·43 for glycerine. Practically no condenser or illuminator goes beyond 1·45.

If the condenser is not placed in "immersion contact," or "immersed," it is said to be used "dry," i.e., with a film of air between its top surface and the slip. Under these conditions its N. A. is limited to 1·0; the obliquity of the light is limited to 90° in air and 41° in the glass of the slip. A ray of N. A. 1·4 would be impossible in air or water; in crown glass it would have an inclination to the axis of about 67°; in flint glass ($\mu = 1{\cdot}67$) its inclination would be about 57°.

(*a*) *Refracting, Dry.*

(1) *The "Spot Lens"* is the earliest of these. It is represented in fig. 4, consisting of a convex lens with a stop S^1 of paper or varnish fixed to its centre, which was occasionally ground flat. It is still sometimes used for very low power work, for which it is effective, as it gives a large field of view.

(2) *The Abbé Condenser and the Achromatic Dry Condenser.*—These are the same in principle, although the quality of the effect they yield is very different, being much superior with the latter.

The principle of both is the same, and is represented by fig. 4, the stop S being placed below the back lens of the condenser. It should be as close to the back lens as possible. The N. A. of these condensers is limited to 1·0, as indeed must be that of any dry condenser.

The Abbe condenser is shown in section in figs. 5, 6, 7; 5 is intended to be used immersed (*i.e.*, with a film of liquid between it and the stop), while 6 is, as a rule, used dry (N. A. 1·0), though it is sometimes made to give N. A. of 1·2, when, of course, it must be immersed. Fig. 7 is a cheap and unsatisfactory form, too often found (it must be for cheapness) in the average "bacteriological outfit." It departs from Abbé's original design by making the back lens plano-convex instead of having its upper surface convex. In this way the defects of the design are made a good deal worse.

The forms 5 and 6 are capable, if properly mounted, of giving an excellent dark-ground effect; 5 with objectives up to ·8 N. A., if used immersed; 6 with objectives up to ·65 or ·7 N. A.

The form 7 is very unsatisfactory for ordinary visual work and practically useless for dark-ground illumination. It is, moreover, often mounted, so that it *cannot* be brought in contact with the slide—which latter is a necessity if the full illuminating cone of N. A. 1·0 is to be realized.

The great defect of the Abbé condenser is that it is not "aplanatic"; it suffers from great "spherical aberration"; either of which expressions means that the marginal rays *m* (see figs. 5, 6, 7) come to a focus much nearer the surface of the lens than do the central rays *c* (this is made worse in 7 by incorrect design). This in itself causes the focal concentration to be most imperfect; and for efficient dark-ground illumination the most perfect focal concentration is required, *i.e.*, as much light as possible must pass through the position of the object.

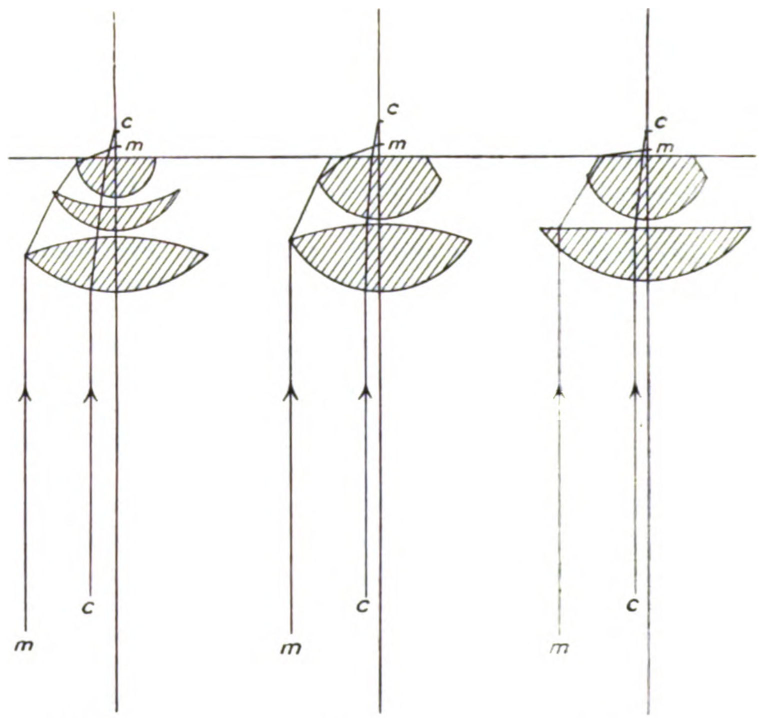


FIG. 5. FIG. 6. FIG. 7.

Moreover, the Abbé condenser is not achromatic; the very oblique rays required for dark-ground work are therefore tinged with considerable colour.

It is fair to state, however, that the Abbé condenser has been quite recently greatly improved by Messrs Watson and Son, who now supply an "improved Abbé," made from Mr. Conrady's computations, greatly superior to the old form, as the present

writer can testify, and without any increase in price. It is, however, still inferior to the achromatic condensers to be now described.

(3) *The Achromatic Dry Condenser.*—This is greatly superior to the Abbé, and is to be preferred for every sort of work. The Abbé does well for all-round visual work—bright ground, that is—especially with a large source of light, but the various achromatic condensers, as made at the present day by Watson, Baker, Swift, and

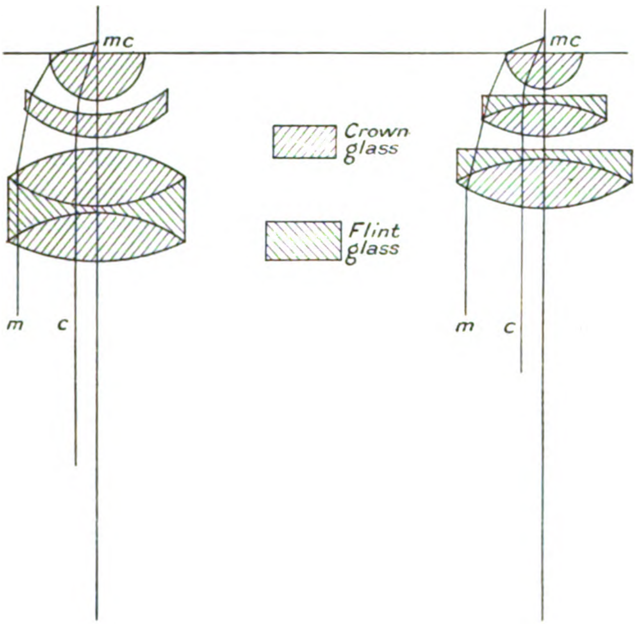


FIG. 8. FIG. 9.

others, though rather more costly than the Abbé, are well worth the extra cost. They can be used for every kind of work: with the top lens removed they give splendid results with low powers (*e.g.* $\frac{2}{3}$ in.): with a stop below the back lens they give brilliant dark-ground effects, with an objective up to N. A. ·7, and even more; being achromatic they transmit beautifully white light; being free from spherical aberration they will fill the back lens of an objective uniformly with light, and thus satisfy the chief condition for critical illumination.

They are made with large or small back lenses—the latter being

preferable for dark-ground work; such condensers are made by Watson, Baker, and Swift. Messrs. Watson's is shown with sufficient accuracy in fig. 8; Baker's in fig. 9. They are corrected for colour by the combination of crown and flint Jena glass; they are, in fact, large objectives and are computed and corrected as such.

The present writer can strongly recommend Watson's "Universal" condenser, shown in fig 8, from his experience of its use; but it is only typical of these excellent productions.

(4) *Refracting, Immersed.*—The Abbé three-lens or two-lens forms (figs. 5, 6) are made with N. A. 1·4 and 1·2 respectively. They can, of course, only give these apertures when immersed, *i.e.*, "oiled" to the slip. Under these conditions they will give fair dark-ground results, with an objective up to ·8 N. A. The achromatic condenser is often made to work immersed, up to N. A. 1·4, but is generally made rather too high in power and small in size to give good results in dark-ground work without a good deal of care. An immersion achromatic condenser of N. A. 1·4, however, of large size, by Leitz, gives admirable dark-ground effects with high powers, though not specially designed for this purpose. (See Leitz's Catalogue C.)

The above are all designed for all-round work, bright as well as dark ground. But there are two illuminators recently introduced by Charles Baker which really fall into the "Refracting, Immersed" class, although they are designed for dark-ground work only. They are modifications of the Abbé condensers (figs. 5, 6). In these, however, the centre of the lower surface of the front lens is ground away and a stop fitted there as well as below the back lens. The central rays being altogether abandoned and stopped out below N. A. 1·0, a much more perfect concentration can be attained in the marginal rays from N. A. 1·0 to 1·4 and 1·2 in the three-lens and two-lens forms respectively. The result is admirable, and these illuminators certainly are as good for dark-ground as anything on the market, besides being easy to use.

These two illuminators belong to the class of special dark-ground illuminators, *i.e.*, in which the central stop is a fixture, so that they can be used for no other purpose. Those now to be described are also special illuminators, for dark ground only.

(*b*) *Reflecting Condensers, Dry and Immersed.*

(1) *The Paraboloid.* — Invented by Messrs. Wenham and Shadbolt in 1852, the paraboloid has enjoyed a good deal of popularity for low-power work. Its action depends on the well-known

property of the paraboloid, that of reflecting to its focus all rays parallel to its axis. Fig. 10 shows the original form of this illuminator, to be used dry, and the action will be evident from the figure. The paraboloid is cut off by a plane at right angles to the axis, and at such a distance below the focus as to allow for the

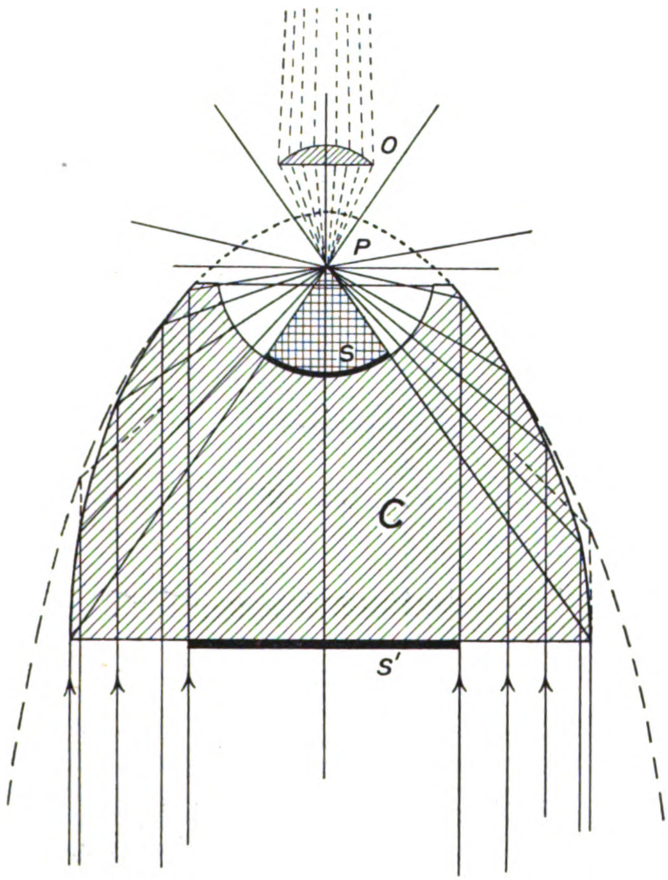


Fig. 10.

thickness of the slip. The top is then hollowed out in the form of a spherical surface with the focus as its centre; this is to allow the illuminating rays to proceed out of the glass, as otherwise they would be totally reflected internally. The paraboloid in this form is practically obsolete, but is still sometimes used for low powers.

(2) *The Immersion Paraboloid.*—Recently, however, the paraboloid has been revived in a slightly different form by the firm of Zeiss and Watson. Fig. 11 shows the "immersion paraboloid" as made by these firms. It will be noticed that the top is no longer hollowed out but is placed in immersion contact with the under side of the slip, and all rays of less N. A. than 1·0 are stopped out, not in this case by a central stop, but by limiting the diameter of the lower face of the illuminator. A stop, however, must be fitted to prevent direct light passing through the illuminator. It will also

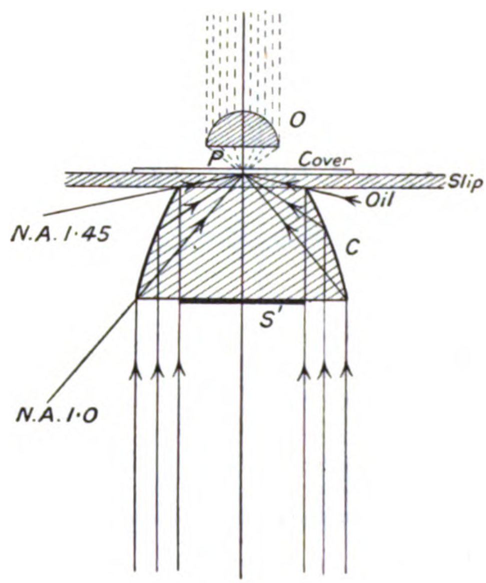


FIG. 11.—Watson-Zeiss.

be noticed that in this, as in all the special dark-ground immersion illuminators, no direct light can get out of the cover glass so long as there is air above it, since the least oblique rays have N. A. = 1·0.

(3) *Stephenson's "Catoptric Illuminator."* — This was the earliest in point of date of all the special immersion illuminators. It was originally suggested previous to 1886 (see illustrations in "The Microscope," by Jabez Hogg, M.D., edition 1886). It has been recently revised by Reichert (of Vienna).

It is very simple, consisting of a plano-convex lens with the central part of the convex surface ground flat and the rest of the

convex surface silvered. A stop is fitted to the plane surface, of the same diameter as the flat part of the convex surface (*i.e.*, the part ground flat). The rays are so reflected internally from the silvered surface as to have an N. A. from 1·0 to about 1·4 They would come to a focus at a point P′, but, being of too great obliquity (more than N. A. 1·0) to emerge from the glass, are totally reflected internally to the object P (fig. 12).

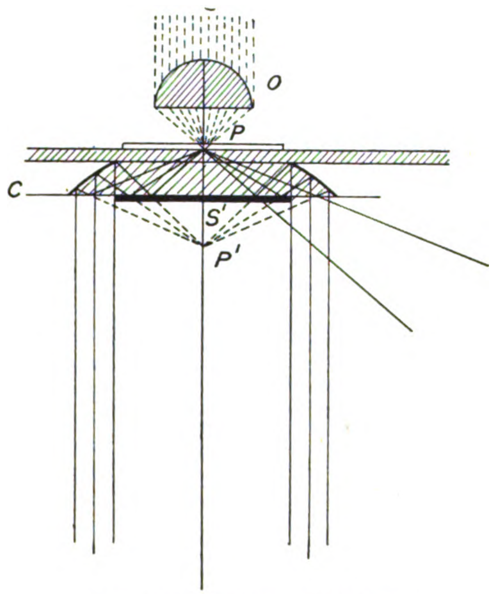


FIG. 12.—Stephenson-Reichert.

(4) *The Leitz Reflecting Condenser*—also made by Swift and Son. This is an extremely ingenious and efficient piece of apparatus, and is much used. In this the rays are reflected twice, first at the lower surface B B of the air-gap A (Fig. 13), and then at the silvered external surface C C of the illuminator; by these two reflections they are brought to a focus at P. The N. A. of the rays reaching P lies between 1·0 and 1·45. The illuminator is composed of two pieces of glass cemented together.

(*c*) *Refracting and Reflecting.*

(1) The only illuminator of this class is Nelson's "Aplanatic Spot Lens," as made by Charles Baker; it is an improvement on

the Stephenson (fig. 12). In the latter the concentration at P is not perfect, since the "spherical aberration" of the single spherical reflecting surface is left uncorrected; the central rays focus higher up the axis than the marginal. This is corrected in Nelson's form by making the lower surface concave, so that the glass takes the form of a meniscus. This concave surface, first by refraction, then by reflection, introduces errors of the opposite nature to those of the upper reflecting surface, and the concentration at P is practically perfect. This is a most effective dark-ground illuminator, and in the writer's hands it has given, perhaps, the best results of any of the special forms. It is shown in fig. 14, in which it will be seen that the rays are both slightly refracted outwards by the concave

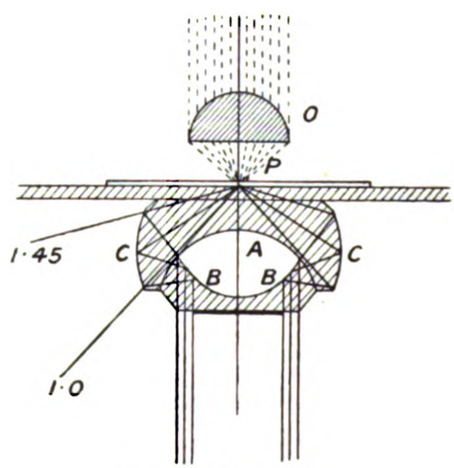


FIG. 13.—Leitz-Swift.

surface, as well as reflected inwards by it. Otherwise the action is the same as in fig. 12.

All the above condensers fall into two broad classes:—

(1) Those available for ordinary illumination, and requiring a special (movable) stop fitted for dark-ground work; this class consists of (*a*) 2, 3, 4.

(2) Those furnished with a fixed stop and intended for dark-ground illumination only, being of no use for ordinary illumination. Such are (*b*) 2, 3, 4; (*c*) 1.

The first class are more properly called "condensers"; the second "illuminators." They differ somewhat in the manner in which they are adjusted for use.

4. Mechanical Details: Stops and Centring Screws.

(*a*) *Stops.*—Whatever optical system be adopted for purposes of dark-ground illumination, a stop is an essential to cut off light of less N. A. than the objective. In the class of special illuminators this is a fixture and is inserted by the makers, being generally

Fig. 14

adjusted to cut off rays up to N. A. 1·0. Sometimes, however, it does not quite do this; it is difficult with some of these special systems to get a dark ground with N. A. of more than ·8, although most of the makers profess that their systems are effective with any dry lens.

When the stop is not a fixture—*i.e.*, in the first class just mentioned, that of ordinary condensers which can be used for dark-ground work—it is usually fitted to a "turn-out" ring, which is generally found pivoted at one side below the condenser to hold coloured screens and the like. For dark-ground work the central stop should be as close to the back lens of the condenser as possible, and the English form of substage fitting (as made by Baker and Watson), in which the "turn-out" ring is between the iris diaphragm and the back lens, is preferable to the continental form in which it is below everything.

If the stop does not give a good result when placed in the turn-out ring, it is not a bad plan to try it just below the top lens of the condenser, unscrewing the top lens for that purpose, and replacing it; but this is more troublesome.

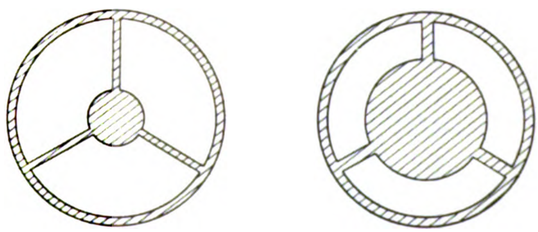


Fig. 15.

Condenser fittings in which a second iris diaphragm is provided *above* the condenser are to be avoided; the upper iris diaphragm serves no useful purpose, and prevents the condenser being brought into contact with the stop, which is most important.

Most opticians supply what they call "wheel stops" for dark-ground illumination; these are seldom exactly suited to the N. A. of the objectives with which they are to be used, and in most cases two only are supplied, a large and a small (fig. 15).

Now the stop, to get the best results, must be just large enough to give a dark field *and no larger*. Hence every objective and every condenser must have stops cut to suit them, and one of the best methods of doing this is as follows:—

In the *exact* centre of the smallest "wheel stop" supplied a small, short pin is fitted. Discs of brass or tin or thin black vulcanite are cut with apertures (*exactly* central) to fit over this pin; a series of these, of varying diameters, being at hand, any one can be quickly slipped over the pin, and, if the diameters of these

stops be properly graded, one can be found to suit any objective. (The writer has seven, varying from ·5 to ·8 in. in diameter, to work with Watson's Universal Condenser, the hub of the wheel being ·42 in.; for N. A. ·65 the diameter of stop required with this particular condenser is about ·62 in.) (Fig. 16.)

A very neat expanding stop, the "Traviss," is made by many opticians. This is a sort of "negative" iris diaphragm opening from the centre instead of closing from the circumference. This allows the diameter of the stop to be closely adjusted, but it is a somewhat expensive and delicate piece of apparatus.

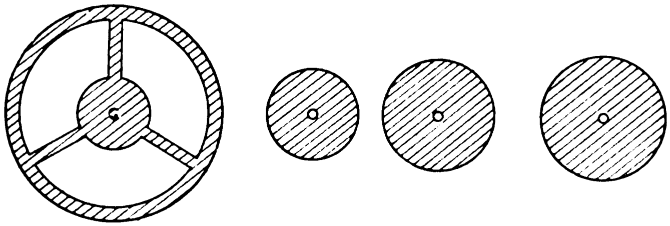


Fig. 16.

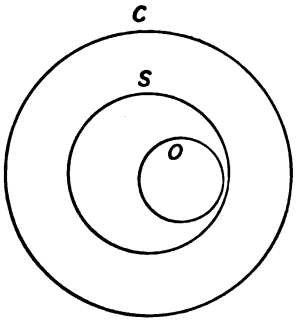


Fig. 17.

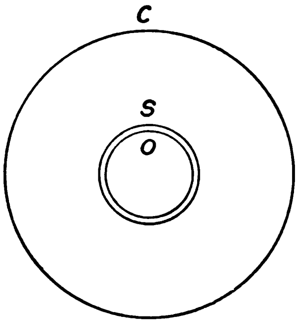


Fig. 18.

(*b*) *Centring Screws.*—Whatever form of stop be employed, it is absolutely necessary that it should be accurately centred to the optical axis of the instrument.

Now, unfortunately, a very large number—one might almost say the great majority—of the instruments found in the hands of students and medical men generally, and practically all those of Continental pattern, have no provision made for this purpose, indeed even the more expensive instruments of continental make are generally guiltless of such luxuries.

This has probably done more than everything else put together to discredit dark-ground illumination, especially with high powers.

Why this is so is evident from figs. 17 and 18, which are intended to show diagrammatically; the circles represent the N. A. of condenser, stop, and objective.

C is the circle representing the N. A. of the condenser, O that of the objective, S that of the stop with a properly fitted turn-out ring; S and C are concentric, and for dark ground S must completely cover O.

In fig. 17 the objective and stop are not centred to one another; in fig. 18 they are; thus it is evident in comparison that in the former case (17) not only is a much larger stop required, but the illumination is not symmetrical, which spoils the definition; moreover, the amount of light passed, which depends on the area between the circles S and C, is obviously greater in the latter case (18).

This is perhaps not so important with low powers, but with high, when the circle O (representing, say, ·7) is nearly $\frac{3}{4}$ the diameter of C (1·0), it makes a great difference.

The statement in many text-books that "good dark-ground effects can only be obtained with an objective below ·6 N. A." is probably the direct outcome of the prevailing neglect of accuracy of centring. A properly centred stop will admit of good dark-ground effects up to a N. A. of $\frac{3}{4}$ that of the condenser, i.e., ·75 with a dry condenser, or, say, 1·0 with an immersion illuminator.

The best English microscopes are provided with centring screws to the substage ring, by which any apparatus placed therein can be at once centred; continental microscopes, as has been said, almost always omit these, but the various pieces of apparatus used (condensers, &c.) may or may not each have their own centring screws. The advantages of the English plan are fairly obvious; it is better to have one centring arrangement for all the apparatus used. The continental opticians apparently claim that their instruments are sent out in perfect adjustment. Even if this is always the case (and it is not always), they rarely remain so. A glance down almost any instrument of continental make or pattern, with the eyepiece removed and the iris diaphragm below the condenser partially closed (an object being in focus with a $\frac{1}{6}$th), will demonstrate this point.

If no centring appliances are fitted to the substage it is an economical and simple plan to have a "centring nosepiece" to take the place of the triple nosepiece usually fitted, as it does not matter in fig. 17 whether O is centred to C or C to O. There is,

however, one disadvantage in this plan; any movement of the objective for purposes of centring to a condenser destroys the accuracy of any records of the position of an object on the slide taken with the divided scales of a mechanical stage. This may or may not be a serious consideration; it is here mentioned in order that it may not be overlooked.

The special "illuminators" in class 2 generally have their own centring screws if fitted to microscopes of continental pattern.

In any case, some centring arrangement is ***absolutely essential*** for good dark-ground effects.

5. Objectives and Eyepieces.

The choice of the objective for dark-ground work is an important matter, as the N. A. is a consideration; and this depends to a large extent on the magnifying power required.

Roughly speaking, a good objective should be capable, when used with a good eyepiece, of giving a total magnifying power of about 800 times its numerical aperture; e.g., a good $\frac{1}{6}$-in. of N. A. ·8 should be capable of working well with an eyepiece giving a power of 640; a $\frac{1}{12}$-in. of N. A. 1·3 should give about 1,000. Beyond about 800 times the N. A. it will be found that no further detail is, as a rule, visible, and the image loses sharpness and brightness. If a $\frac{1}{4}$-in. of N. A. ·65 is good enough to stand an eyepiece of, say, × 20 power (used on a $6\frac{1}{2}$-in. tube), it will give a power of about 500, which should be sufficient for most purposes.

But in dark-ground work the quality of the objective is all-important, for the simple reason that it is worked at its full aperture, though, as explained later, the oil-immersion lenses are an exception to this rule. In ordinary work, where the magnifying power of an objective is not usually pushed so far as the limit given above, and where the iris diaphragm beneath the condenser is in use, where, moreover, the average Abbé condenser is fitted—which is quite incapable of filling with light the back lens of a $\frac{1}{6}$th—the defects of the marginal zone of the objective, due to spherical aberration, are of less moment.

But in dark-ground work there is no hiding behind the iris diaphragm, so to speak. Every defect in the objective shows, and in fact dark-ground illumination under a high power is about the severest test that can be applied to any objective.

Under the circumstances it is impossible to deny that the apochromatic objectives, as made by all the continental firms (and by Powell and Lealand, and Swift and Son, in England), are

greatly to be preferred. In a note at the end of this paper will be found more about the "apochromats," but they are here mentioned because, though very costly, they are certainly the best.

If an aperture exceeding about ·75 is required, the dry condenser (as pointed out above) is hardly sufficient, and one of the oil-immersion illuminators must be used; but an aperture of ·75 is probably sufficient for most purposes. It is a moot point, and one upon which neither opticians nor expert microscopists are agreed, whether an oil-immersion objective has any great advantage in dark ground-work over a dry. Its aperture has to be reduced to below 1·0 N. A., which so far puts it on a par with the dry lenses as regards defining and resolving power, but it has the advantage that the thickness of the cover glass is immaterial (since cedar oil and crown glass have the same refractive index), so long as the cover glass is not too thick to allow focussing, which is sometimes the case.

On the other hand, the necessity of using oil between objective and cover is often a serious drawback, especially if the film of liquid under examination is too thick; under these circumstances the use of the fine adjustment for focussing sometimes drives the objects out of the field of view, or the cover (if thick) may even stick to the objective. Moreover, if it is desired to examine the film of liquid subsequently with a dry lens, the oil must be removed from the cover glass, a matter, with a temporarily mounted specimen, of some difficulty.

A good water immersion is free from the latter trouble, but for some reason or other water-immersion lenses are not very popular.

Any immersion lens, being of greater N. A. than 1·0, must have a diaphragm fitted to reduce its aperture. For this purpose a "funnel stop" is usually fitted close to the back lens, and can be obtained from the makers, taking, usually, the form of a separate mount to which the optical portion of the lens can be screwed. These "funnel stops" often reduce the N. A. to ·8 or even ·7, which seems unnecessary, if the illuminators are what they profess to be. Of course the N. A. of a dry lens can be reduced in this manner; e.g., a $\frac{1}{6}$th, from ·82 to ·65 N. A.

Objectives of good quality can now be obtained from any of the first-class makers; the "fluorite lenses" of Leitz, especially his "$\frac{1}{12}$ *a*," approach very closely to the apochromats; as also Watson's heloscopic series, of which the $\frac{1}{4}$-in. N. A. ·65 is particularly good. Of the ordinary achromatics, Watson's $\frac{1}{6}$-in. N. A. ·74 and Baker's $\frac{1}{6}$-in. N. A. ·65 are very suitable, as also these

makers' $\frac{1}{12}$ths which are excellent. These are only a few out of many excellent objectives.

Of the apochromats, Zeiss's 12 mm. ($\frac{1}{2}$-in.), N. A. ·65, is perhaps the finest dry lens on the market.

Eyepieces.—The ordinary Huyghenian eyepiece as commonly supplied gives fairly good results with achromatic objectives; but the "compensating eyepieces made by all continental and some English opticians are better, though more costly. Watson's very excellent "heloscopic" eyepieces may be also recommended. Which eyepiece is chosen depends on the magnifying power required; for a $\frac{1}{2}$-in. N. A. ·65 (Zeiss apochromat or Watson heloscopic) a high power eyepiece, say $\times$ 27, is necessary to give $\times$ 540; for a $\frac{1}{12}$th, a low power eyepiece, such as $\times$ 6, is quite sufficient. The makers' catalogues give tables of magnifying powers which may be consulted; but the above, with the addition that a $\frac{1}{6}$th requires about $\times$ 12 in the eyepiece, may be of some assistance.

The compensating eyepieces of Zeiss, when made for the short (160 mm.) tube, are marked with fictitious numbers, intended to allow for the shortness of the tube. Without discussing the merits of this rather complicated system (in which the power of the objective is supposed to be constant while that of the eyepiece varies, whereas the former really depends on tube length, and the latter is really constant), it is advisable to point out that these eyepieces, when made in the usual small size, really have actual magnifying power nearly 50 per cent greater than those they are marked with; e.g., the "18," used as a magnifier, really has a power of about 25½. These eyepieces can be used in any tube length. The magnifying power of a microscope can be found thus, with fair approximation: "Divide the tube length by the focal length of the objective and multiply the result by the (actual) power of the eyepiece"; e.g., a $\frac{1}{6}$ (4 mm.) used on 200 mm. tube with a $\times$ 10 eyepiece gives power $\frac{200}{4} \times 10 = 500$, approximately. The shorter the tube the more powerful must the eyepiece be to give the same total power.

Apochromats, and high-power achromats have an inherent error which cannot be removed; they form a larger image in blue light than in red. The compensating eyepieces are given the opposite error (red magnified more than blue) to correct this. Watson's heloscopic eyepieces have an adjustable eye-lens, so that the correction can be varied to suit any objective.

6. Illuminants: Electric, Gas and Oil.

One of the first things to strike anyone who reads one of the catalogues of these modern dark-ground illuminators is the great stress laid by the optician on the necessity for a very powerful illuminant. No doubt, for some very special work (such as "ultra-microscopy," or instantaneous photography of living organisms), the electric arc-light or the lime-light is necessary. But for ordinary use, where the object is the detection of living micro-organisms (*e.g.*, *Treponema pallidum*), an exceptionally powerful illuminant is not needed.

Those who have electric light at their disposal will find that the ¼ or ½ ampère Nernst lamp, worked on a *continuous* current, and giving a light of from 16 to 32 candle-power, is more than sufficient; but it is not satisfactory on an *alternating* circuit, such as is very generally found at the present time. Also, the Nernst lamp requires care in joining up; if the current is sent through it the wrong way the life of the lamp is greatly shortened.

The ordinary incandescent lamp, whether with carbon or metallic filament, is not well suited to microscope work, unless the bulb is "frosted," or a ground glass screen interposed, either of which considerably reduces the power.

A lamp by Stearn, however, in which the filament (carbon) is wound into a very small space, gives very fair results for dark-ground work, though the illumination of the field is not very even, nor is the definition quite so good as that got with the lamps to be described.

Stearn's lamp is also of great value in ordinary visual work, with a ground-glass screen placed as near the lamp as possible. A good plan is to place a disc of finely ground glass in contact with the plane side of an ordinary small size "bull's-eye" or "stand" condenser, and to place this in contact with the bulb of the lamp.

It will probably be seldom that an acetylene installation is available in the ordinary laboratory; if such is handy, no illuminant is superior, and an ordinary acetylene bicycle lamp, if it can be induced to burn quite steadily, gives extremely good results; but it is not always easy to avoid sudden changes in the height of the flame, which make a considerable difference to the illumination of the field. If ordinary home gas is available the incandescent mantle gives an excellent result, but with a good deal of heat. The various lamps made on the same principle, but working with petrol or spirit vapour, may also be mentioned. But for ordinary work, at magnification up to 700 or 800, or even more, an ordinary

small paraffin lamp giving a *flat* flame is quite satisfactory if it is trimmed and adjusted to work at its best.

It should have a *flat* wick ½ in. or ¾ in., or even more, in width —round, hollow wicks are unsuitable—and the chimney should be straight-sided, or at any rate without any sudden constriction in the neighbourhood of the flame. What is known as a "night-light" chimney is excellent. The chimney must not be large, since it may be necessary to place an auxiliary condensing lens quite close to the flame, nor too small, or it will crack. All this can be obtained for a shilling or two; if something more elaborate and scientific looking is required, any English optician will supply most efficient microscope lamps, with metal chimneys and flat glass slips, at prices up to £3 or £4, but it is very questionable whether the results obtained are appreciably superior to those got from a simple small lamp which can be easily moved about and readily replaced if necessary.

The lamp should have a small base, so that any apparatus can be brought close up to the flame; and if the reservoir is of glass, so much the better, as it is always possible to see if the supply of oil is sufficient, and the annoyance of the light going out in the middle of an important observation is avoided. One great disadvantage of the more powerful electric lamps is the great amount of heat produced; another is their dazzling effect on the eyes when adjusting the apparatus previous to observation; neither of these drawbacks is met with when using the paraffin lamp; and if the lamp is surrounded by a simple and easily made cardboard screen, and the room darkened as far as possible, it will be found that a surprisingly bright effect can be obtained.

In short, for ordinary observation with a dark ground, a paraffin lamp is quite sufficient; in exceptional circumstances, and for exceptional work, a more powerful illuminant may be necessary. The paraffin lamp can be obtained anywhere and is easy and pleasant to use.

7. Bull's-eye or Stand Condensers.

It is generally, though not invariably, necessary to place some sort of condensing lens between the lamp and the mirror. This is not so much for the purpose of increasing the light as to enlarge the illuminated area of the field of view. If the edge of the flame is used alone the area over which the bacteria can be seen is very limited, though in this area the illumination is good; when a suitable "stand condenser" or, as it is usually called, "bull's-eye" is placed in front of the flame the organisms can be seen all over the

field of view. Also, the final focussing of the light to obtain the best possible effect is best done by moving the bull's-eye.

These bull's-eyes are supplied by all opticians, generally mounted on a ball and socket joint for illumination of opaque objects. They are usually plano-convex lenses of short focus, and can be used for purposes of dark-ground illumination, though for this their focus is usually somewhat short.

A better plan is to use a convex lens of about 1¾ in. to 2 in. aperture, and about 3 in. focal length. This may be mounted in a metal ring and supported on a brass rod sliding in a hole in a block of hardwood, so that its centre can be brought from 3 in. to 5 in. from the table and level with the lamp flame. If this lens is composed of two convex lenses, each about 5 in. focus, and separable, so that one only can be used if desired, and an iris diaphragm added, it will be found a most useful accessory for all sorts of microscopical work.

It will be found a good plan to set the microscope, raising it off the table by a block of wood if required, so that the centre of its mirror is level with the lamp flame. The lamp may then be placed in front of, or (as preferred by the writer) to the left of, the microscope. It will be found that under these conditions the various adjustments can be much more readily made than if the flame of the lamp and the mirror differ widely in height from the table. The position of the lamp on the left-hand side of the microscope has the advantage that the light of the lamp can be screened from the observer's eyes with great facility.

Before leaving this part of the subject the "aplanatic bull's-eye," as computed by E. M. Nelson and made by the leading English opticians, must be mentioned. This is theoretically a more perfect form of bull's-eye, and for some work—notably photo-micrography—is greatly superior to the ordinary form, but besides being much more expensive, it is rather too short in focus for dark-ground work. It can be used, however, for this and a large number of other purposes in microscopy.

I leave to the last the large globe of water recommended by some continental firms. It is crude and unsatisfactory, and at the best wastes a good deal of light.

8. Practical: Adjustment of Apparatus for Use.

(*a*) *With Condenser and Stop.*

(*b*) *With Dark-ground Illuminator.*

(*a*) The details of the various adjustments to be carried out differ somewhat, according as a "condenser" with movable stop

or an "illuminator" with fixed stop is in use. The former will be considered first as the simplest and easiest to set up.

As an example, it will be assumed that the objective used is a $\frac{1}{6}$th of about N. A. ·65, the eyepiece × 12 (or "No. 4"), and the condenser, a dry achromatic, such as Watson's Universal. A paraffin lamp with $\frac{1}{2}$-in. or $\frac{3}{4}$-in. wick will be assumed as the illuminant.

It is always well to have some object readily visible and easily focussed when adjusting, and it will be found a great saving of time to have at hand a "spread" slide of diatoms or other bright objects (polycistina, &c.). This can be obtained from any dealer. The slip should not exceed 1·0 to 1·2 mm. in thickness, and the cover should be thin.

Place the lamp with the *edge* of the flame presented to the mirror and about 12 in. from it; see that the flame is level with the centre of the mirror.

Remove objective and eyepiece. Open wide the iris diaphragm of the condenser (if there are two, the lower iris is always meant).

Looking down the tube, set the flame central in the top lens of the condenser by means of the mirror.

Place the diatom slide on the stage and focus with a $\frac{2}{3}$-in. objective and a × 6, or No. 2, eyepiece.

Now focus the condenser, *i.e.*, obtain a sharp image of the edge of the flame in the centre of the field.

Substitute the $\frac{1}{6}$-in. for the $\frac{2}{3}$-in. and focus the diatom.

Remove eyepiece, close iris diaphragm; it should close concentrically with the back lens of the objective. Make it do so by the centring screws (either to condenser or objective).

Set the flame-image central by means of the mirror.

Place the smallest stop in the turn-out ring; open the iris. This stop will probably be too small to cut out all the light from reaching the objective, so that on looking down the tube (the eyepiece being still out) the stop will be seen surrounded by a bright margin.

Centre the stop to the back lens of the objective.

Insert a stop in the turn-out ring, which just appears to fill the back lens of the objective. (*N.B.*—Do not alter focus of either objective or condenser.)

Turn this stop out of the axis, replace eyepiece and, if necessary, set the image of the flame central by means of the mirror.

Turn the stop into the axis. The diatoms should now be illuminated in that portion of the field on which the image of the

flame fell when the stop was not in use. If not, a slight alteration in the focus of the condenser (generally raising) may be necessary.

Rack the condenser up *slowly* to touch the slip. This will be recognized by the diatoms suddenly going out of focus. The condenser should be just, and only just, clear of the slip. (The diatoms may now be no longer illuminated.)

Place the bull's-eye or other auxiliary lens (section 6) about 3 in. from the lamp, and with its centre on a line from lamp to mirror. Keep it square to this line. (A disc of paper laid on the mirror is a great help.) If the bull's-eye is plano-convex turn the plane side to the lamp.

Move the bull's-eye to and fro along this line until the best effect is produced. The diatoms should now shine brightly on a dark ground, but if the ground is not dark a large stop may be required, or the condenser may have to be depressed a little.

There are sure to be minute points of light here and there in the field. Get one in the centre and put it a little out of focus. It should expand into a circular symmetrical disc; if it is "one-sided," the mirror is probably not quite right.

The adjustments being now complete, the slide of living bacteria, or whatever is to be examined, may be introduced, and the × 12 eyepiece employed.

If it is desired to use another objective, which may very likely be slightly different in centring, one must not touch the mirror, but bring things into adjustment by the centring screws.

It is quite possible that a slightly larger stop may be required if the objects are in a watery medium than if mounted in balsam, but not much larger.

The above procedure is equally efficient for low powers, *e.g.*, ⅔-in., but for them the top lens of the condenser should be removed and the flame inclined or placed "broadside on."

The procedure with an oil-immersion achromatic condenser (*e.g.*, that by Leitz) is precisely similar, and it will be found that the N. A. of the objective can be much greater—up to ·8 or even ·9. The condenser must be in "immersion" contact with the slip, either oil or water being interposed. This limits the range of adjustment of the condenser, since this contact must be maintained perfect.

The effect with a dry achromatic condenser in contact with the slip is often improved by interposing a drop or two of oil or water so as to make immersion contact. This is not so much to increase the N. A.—though it may do so slightly—as to avoid loss of light by reflection from the lower surface of the slip.

The Abbé condenser, either dry or immersed, is adjusted as above.

(*b*) *The Special "Dark-ground Illuminator."*—The process of centring these is somewhat different. Place the lamp as before and remove the objective, eyepiece, and condenser. Set the flame-edge central in the tube by the mirror.

Place the illuminator in the substage. In the centre of its upper surface will generally be found a minute cross, or one or two small concentric circles engraved on the glass. With a 1-in. or $\frac{2}{3}$-in. objective, a low eyepiece, and the bull's-eye in front of the lamp (if required), these marks or circles can be seen and centred by means of the centring screws (either in nosepiece or substage). It will probably not be found very easy at first to see these circles at all; a needle-point or small piece of white paper placed on the top surface of the illuminator will give an idea of the focus, and, if necessary, the circles may, in addition, have light thrown on them from above.

Nothing but practice will enable these marks or circles to be easily seen. When found, they should appear somewhat faint on a dark background. The circles are usually just small enough to be got into the field of a $\frac{2}{3}$-in. objective with a low eyepiece. Once the circles are centred all is "plane" sailing. A drop of cedar oil (or several, according to size) is placed on the upper surface of the illuminator, which is racked down a quarter of an inch or so below the level of the stage. Now place the diatom slide on the stage, keeping the $\frac{2}{3}$-in. or 1-in. on the nosepiece. Rack the illuminator up slowly until the oil makes contact with the slip; this will be recognized by a peculiar flash of light and the appearance of a small illuminated spot on the upper surface of the slide. Continue racking up the illuminator until it lifts the slide. The film of oil between the illuminator and slip should now be complete and free from minute air-bubbles—which last is most important. The illuminator may now be gently lowered until the slide just rests on the stage. If it is lowered further there is a great risk of losing contact, and air-bubbles are almost certain to make their appearance, which will ruin the dark ground. All these operations, at any rate at first, should be performed very deliberately.

On looking into the eyepiece a small spot in the centre of the field should be found brilliantly lit up, and the diatoms may be focussed. The mirror may, if necessary, be moved slightly to get the best effect, but the centring screws should not be touched.

The $\frac{1}{6}$, or whatever objective is to be used, and the proper

eyepiece may now be employed. It is possible, in fact probable, that the spot of light in which the diatoms are seen illuminated will no longer be central. It must be made so *by means of the centring screws only, and the mirror must on no account be touched.*

Now bring the bull's-eye into action, observing the same precaution as given in the last section; move it to and fro and centre it until the best effect is produced. The whole field of view should now be illuminated, and the diatoms should stand out brightly and sharply from the dark ground.

It only remains to insert the slip with the film of liquid to be examined; if it differs much in thickness the bull's-eye may have to be moved slightly.

When changing a slip with an illuminator in immersion contact with its lower surface, do not attempt to lift the slip from the stage at once; the illuminator should be *slowly* lowered till the oil ceases to make contact; if this is done too quickly the slip may be (and has been, in the writer's experience) broken by the adhesion of the oil, especially if the latter has become thickened by age or cold, and air-bubbles are sure to appear.

Too much care cannot be taken to avoid dust and air-bubbles anywhere between the illuminator and objective. They (especially air-bubbles) become luminous in the powerful light transmitted and form secondary sources of light which, not being in the focus of the objective, interfere greatly with the darkness of the field. Both slips and covers must, for all dark-ground work, be scrupulously clean and the film of liquid must also be kept as thin as possible, the excess being blotted off. The covers should be as thin as possible—not more than ·15 mm. or ·006 in., if such are obtainable—and the slips should be of the thickness prescribed by the makers of the illuminator in use, though it is always as well to make a few experiments in this particular direction, as the writer has occasionally found that a somewhat thicker slip than that recommended by the makers gave considerably better results. This is not nearly so important in the case of dry condensers, though with them the thickness of the slip should be between 1·0 and 1·5 mm.

For further hints as to the setting up and use of these special illuminators the maker's pamphlet, more especially that of Leitz, may be consulted with advantage.

There is one further point which should not be overlooked: these illuminators are usually brought into optical contact with the slip by means of a drop of immersion oil. If objects mounted in

balsam are under observation, no doubt this is necessary to bring out the full N. A. of the illuminator; but if we are examining living organisms in a watery liquid (index 1·33), there is no point in attempting to transmit rays of greater N. A. than 1·33, and water will do perfectly well to connect illuminator and slip—or glycerine, if preferred. Either of these is more cleanly than oil, more easily removed, and more free from air-bubbles.

The writer draws attention to this as a thoroughly practical point and one which he has not seen mentioned in any published work on the subject.

(It may be of interest to note that the ordinary immersion $\frac{1}{12}$ in. objective often works nearly as well with glycerine as with oil, if the draw-tube is pulled out 2 in. or so. This may occasionally be useful.)

9. General Remarks.

In the present paper great stress has been laid on the utility of the achromatic condenser (especially the dry variety) in dark-ground work. This is because of the obvious convenience of being able to use one and the same condenser for all the various kinds of work that a microscope can be called upon to perform, instead of having to use a different, and not very easily adjusted, illuminator, possibly even a different microscope, for dark-ground work.

Even an Abbé, if good, will do well; but the advantages of the achromatic condenser will be obvious to anyone who tries one.

The writer has been assured by several medical men that a power of 500 to 600 is sufficient for most dark-ground work; with this power such an object as *Treponema pallidum* is readily visible, and this power can be obtained with any good objective of N. A. ·65 to ·7, used with a suitable eyepiece. (See photo at beginning of paper.)

Again, the convenience of being able to change in a few seconds from bright to dark ground, and *vice versa*, by merely turning in or out a ring carrying a stop, is too obvious to need comment.

It may be admitted that for very high powers (1,000 to 2,000) the special dark-ground illuminators are almost necessary. But how often are such powers wanted? Do they compensate for the much smaller extent of the field of view? If a moderate power, like 500 to 600, is sufficient, it will generally give the best results and be more pleasant in use; and for such powers, even up to 700, the dry achromatic condenser gives such excellent results that it is a pity that its capabilities are not more fully appreciated.

One advantage of using a moderate N. A., such as ·65 or ·7, may be mentioned; moving objects do not go out of focus so rapidly as with N. A. ·95 or 1·0. In other words, the "depth of focus" is greater. This is often desirable. It would be a great improvement if some better method than the present of centring the "dark-ground illuminators" were introduced. The marks and circles on the front are not easy to see and often cause much waste of time; a minute aperture in the stop would be much better, to be focussed with a $\frac{2}{3}$-in. objective and closed by a small stop when not required. The writer ventures respectfully to suggest this to any opticians who may read this paper.

For further information regarding the subject of this paper the following works may be consulted:—

"The Microscope and its Revelations," by Dr. Carpenter; 8th edition by Dallinger.

"Microscopy," by E. J. Spitta.

"Modern Microscopy," by Cross and Cole. (The last is an excellent elementary treatise on the general use of the microscope.)

The photograph at the beginning of this paper was taken with a view of demonstrating the possibility of seeing and recognizing such an object as *T. pallidum* with a power of 500. If the photograph is held 12 in. from the eye it will appear precisely as under this power in the microscope. A good $\frac{1}{6}$th objective of the same aperture as the Zeiss $\frac{1}{2}$-in. (0·65) should show the organisms almost equally well, though not quite so free from secondary colour.

Note A: Tube Length, Cover-glass Thickness, and the Correction Collar.

All modern objectives are corrected for a definite tube length and, in the case of dry (and some water-immersion) lenses, for a cover glass of definite thickness. Oil-immersion lenses, in which the refractive index of the oil is identical with that of the cover-glass, are practically independent of cover-glass thickness, since the oil, the cover glass, and the Canada balsam used for mounting form a homogeneous medium extending from objective to object, through which light rays pass undeviated.

But in the case of a dry lens the thickness of the cover makes an enormous difference to the definition, especially with large apertures; and, although the objective is corrected, as said above, for a definite thickness of cover glass and a definite tube length, these two quantities depend to some extent on one another; *i.e.*, if

an objective, say, a $\frac{1}{6}$th in. of N. A. ·80, works well with a cover glass ·17 mm. thick, and a tube 160 mm. long, it will work equally well with a cover glass, say, ·15 mm. thick, and a tube 180 mm. or so in length; but it will not work well with the ·15 cover glass on the 160 tube, nor with the ·17 cover glass on the 180 mm. tube.

This circumstance gives us at once a means of correcting for unusual thickness, or the reverse, in the cover glass; for a thick cover glass we can shorten the tube, for a thin one we can lengthen it out by pulling out the draw tube. This is very important in dark-ground work, as the objective is used at full aperture.

The following is a simple rule for obtaining the best definition :—

Select a small bright point in the field and put it out of focus by first raising, then lowering, the tube, using the fine adjustment. If the tube length is correct the point will expand into a disc, which should present the same appearance in either case (within and without the focus). But if the tube length is incorrect the point will have a *misty* appearance in the one or the other case. If this misty look comes on on lowering the tube (i.e., within the focus), the tube must be shortened by pushing in the draw-tube; if outside the focus, or on raising the tube, the draw-tube must be pulled out.

In short, the draw-tube must be moved in the same direction as the tube was when the misty effect was obtained.

A little practice will soon make this plain. The draw-tube should only be moved, say, 10 mm. at a time.

Once the proper position of the draw-tube has been found for any given thickness of cover glass (the thinner the better), it should be recorded and adopted in future observations, the thickness of cover glass being kept constant.

The same end is often attained by means of the "correction collar." This is a graduated ring which alters (by a screw action) the relative positions of the component lenses of the objective. It is fitted to the highest class of dry lenses, such as Zeiss's apochromats; often to the water-immersion—occasionally, but now-adays very seldom, to the oil-immersion—objectives. It is so seldom found in an ordinary outfit that it is merely mentioned here; its use really requires a personal demonstration.

One important point remains. The draw-tube is not fitted for the purpose of increasing magnifying power, and should not be used for that purpose except with low powers. With high powers this practice simply ruins the definition; the objective only works at its best at a particular tube length, and is worse at any other. To increase the power a more powerful eyepiece must be used.

NOTE B: ACHROMATIC AND APOCHROMATIC OBJECTIVES.

The achromatic objectives, whether of the old construction of flint and crown glass, or, as at the present time, of the Jena optical glass, cannot be made to combine more than two colours of the spectrum into the focal point. A considerable quantity of outstanding colour is always noticeable, called the "secondary spectrum."

In 1886, Abbé, by the use of the mineral fluorite in conjunction with these glasses, succeeded in eliminating this secondary spectrum, and the apochromats of Zeiss and others were the result. They are expensive because of the rarity of suitable fluorite, but their superiority to other objectives is beyond question, especially for photo-micrography.

Objectives containing fluorite lenses, though not quite apochromatic, are made at much lower price by Leitz and others, and can be strongly recommended for dark-ground work.

Besides their superiority in colour-correction, the apochromats possess the advantage of practically perfect correction for spherical aberration, this correction being made for two colours instead of for one, as in the achromats. In consequence the images given by apochromats leave nothing to be desired; they are beautifully sharp and colourless. Such objectives as the Zeiss 12 mm., N. A. ·65, the 4 mm. (N. A. ·95), and the 3 mm. or $\frac{1}{8}$-in. (N. A. 1·4) must be seen to be appreciated, though their high price must always be an obstacle to their extended use.

A STUDY IN MEDICAL TACTICS.[1]

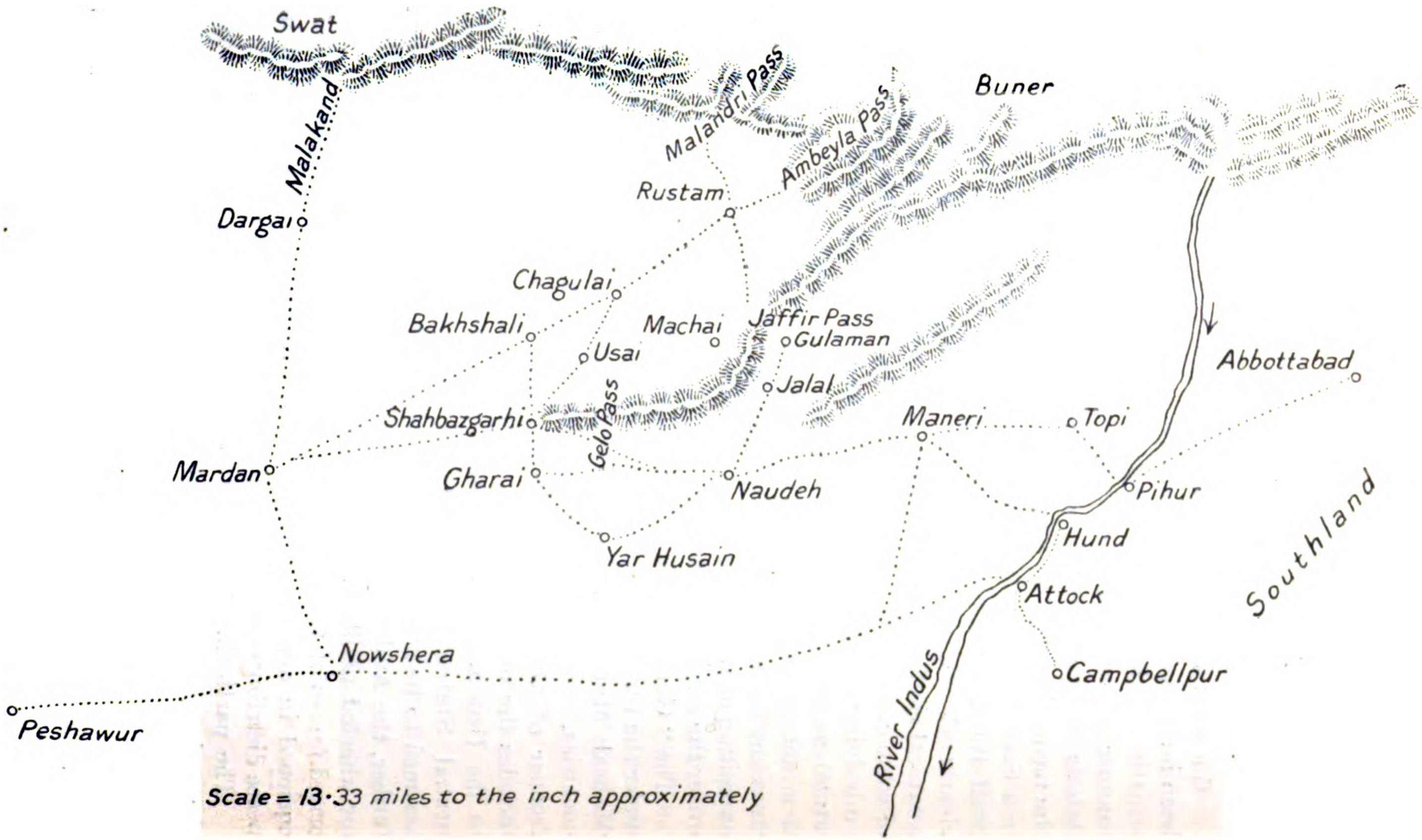
By Colonel R. H. FIRTH.

Looking through the literature dealing with Staff Rides, one has been impressed with its weakness as to details and analysis of the situations arising in the course of individual rides, also as to the manner of or reasons for coping with those situations. These defects are particularly noticeable in the case of the handling of the medical units. To an officer of our Corps, ordered to take part in a Staff Ride for the first time, the absence of any account of a Staff Ride, in which the details and reasons for action taken are clearly set out, is a serious want. Having recently returned from a typical Staff Ride with the 1st Division which presented situations of some complexity, it has occurred to me that, perhaps, a statement embodying one's own experiences and manner of dealing with the situations might be of use to others. In submitting this account, it is not assumed that the particular action taken, or the dispositions made, were necessarily correct; the statement is but an exposition of what seemed to the writer, as A.D.M.S., to be the best under the circumstances.

The "General Idea" was that for all Staff Rides held in 1913, under the direction of the Northern Army Commander, and for the Medical Manœuvres in the 2nd Division. It postulated two countries, namely, Northland and Southland. The common frontier of the two countries being the River Indus. Northland includes the minor States of Swat and Buner, which are federated in the Union. Kohat, Bannu and Derajat are independent and neutral States. The capital of Northland is Kabul, which is assumed to be connected with Peshawar by a broad-gauge railway; further, the Ambeyla and Malandri passes from Buner are passable for wheeled artillery. The capital of Southland is Lahore. The armed forces of these two countries are taken to be organized and equipped in accordance with Indian War Establishments, and in peace distributed in the districts after which they are named.

The particular Staff Ride to which this article refers dealt with the early or first phase of the conflict between Northland and Southland. It covers the first movements of the Abbottabad

[1] Being an address given to medical officers and assistant surgeons at Peshawar on January 10, 1913.



Swat
Malakand
Dargai
Malandri Pass
Ambeyla Pass
Buner
Rustam
Chagulai
Bakhshali
Machai
Jaffir Pass
Gulaman
Usai
Jalal
Shahbazgarhi
Gelo Pass
Maneri
Topi
Abbottabad
Mardan
Gharai
Naudeh
Pihur
Hund
Yar Husain
Attock
Southland
Nowshera
Campbellpur
River Indus
Peshawur
Scale = 13·33 miles to the inch approximately

Fig. 1.

Division and the Abbottabad Cavalry Brigade, belonging to Southland, who invade Northland's territory on January 1, 1913, by crossing the Indus at Pihur (sketch, fig. 1). These troops are weakly supported by the Campbellpur Infantry Division and Cavalry Brigade now at Attock, also by a division at Fatehjang, and one at Rawalpindi. Northland's forces consist of an Infantry Brigade at Mardan, two Infantry Brigades and one Cavalry Brigade at Nowshera; these are mobilized. There are in addition, a division at Peshawar, a division at Swat, a division in Buner, and one in Kabul, all of these will be completely mobilized in about two weeks.

By 8 a.m. on the morning of January 2, all the Abbottabad Division was clear of the Indus. At that time the division was at Topi, and the Cavalry Brigade at Maneri. From this hour the Cavalry Brigade disappears from the narrative of the Staff Ride, except as a means by which information was received from our front. The history of its medical units did not come within the sphere of activity of the writer, who was A.D.M.S. of the Infantry Division. The Cavalry Brigade had its own Senior Medical Officer, and his dispositions were independent of the Divisional Assistant Director of Medical Services. At 8.30 a.m. the G.O.C. of the Abbottabad Division received the following instructions from General Headquarters, Southland: "According to reliable information at least one brigade of the enemy is at Mardan. The bulk of the Nowshera Cavalry Brigade appears to be still at Nowshera, and there appear to be no signs of a forward movement from Peshawar. No change in the location of our forces. The C. in C. intends to advance at daybreak to-morrow with the Campbellpur Cavalry Brigade, and the Campbellpur, Fatehjang and Rawalpindi Divisions towards Peshawar, with the object of engaging the enemy's forces in the Peshawar Valley before reinforcements arrive. Your task will be to secure these operations from interruptions on the part of the Swat and Buner Divisions. Reports from secret service agents in Swat and Buner state that these two divisions will be in a position to move in some strength earlier than was anticipated. Your advanced base will be Hund, and the I.G.C. has been directed to push up supplies to that place; these may be expected to commence arriving by the morning of January 4. General Headquarters remain for present at Attock."

The outcome of this was that the G.O.C. issued immediate orders for the advanced guard to be formed of one Squadron Guides Cavalry, one battery R.F.A., one company of Sappers and Miners,

the 1st Infantry Brigade and complementary ammunition, medical and supply columns. The D.A.A.G. inquired what medical units were to be detailed in Orders. The A.D.M.S. detailed Section A of No. 2 Field Ambulance and Sections A and B of No. 102 Field Ambulance. It may be stated here that the authorized medical units for the division were five, namely, two British and three Indian Field Ambulances. The numbers were Nos. 1 and 2 British with Nos. 101, 102 and 103 Indian. In the narrative which follows the qualification British or Indian will be omitted, partly to secure brevity, but mainly because practical experience indicated that with large numbers of casualties it is impracticable to discriminate between British and Indian; in other words, a field ambulance is a field ambulance no matter how labelled.

The question arises here on what principle did the A.D.M.S. select A of No. 2, with A and B of No. 102 to go with the advance guard. Why not have detailed some Sections of Nos. 1 and 101? A consideration of the situation, as outlined in the "General Idea," coupled with the information and orders from headquarters, indicated that the division was evidently being pushed into the enemy's country more or less unsupported, and that for the next three days we should not be able to feel ourselves fully linked up with an organized line of communication. It was necessary to be prepared to make a provisional line of communication with our Supply Park, then at Pihur, and ultimately to be able to link up with the true head of the Line of Communications which would be at Hund on January 4. On this assumption or appreciation of the situation, it was deemed desirable to ear-mark from the outset at least two field ambulances for evacuation work and if need be distribute them over a series of posts; at the same time utilising their bearer companies as a basis for one or more ambulance columns. From an administrative point of view it was clearly better to keep to the same numbers in place of utilizing indiscriminately sections from ambulances with different numbers. For these reasons, therefore, No. 1 and No. 101 were at the outset held in reserve as essentially evacuating field ambulances. The former was a so-called British and the latter a so-called Indian Medical Unit. As events developed, this principle was adhered to, only Field Ambulances 1 and 101 were detailed for post and evacuation work. In the name of the G.O.C. the A.D.M.S. inquired by telegram of the I.G.C. on what date a clearing hospital might be expected to be open at Hund. The reply received was to the effect that such would be open on the evening of January 4 and be capable of receiving 200 sick and casualties.

The advanced guard was ordered to march at 9.30 a.m. January 2, and halt at Naudeh. It was timed to reach there at 5 p.m. The main body was ordered to leave Topi at 10.30 a.m. for Maneri; it consisted of Divisional Headquarters, two squadrons of Guides Cavalry, two Batteries of Field Artillery, two Mountain Batteries, a Sapper and Miner Company, the 2nd and 3rd Infantry Brigades, and Ammunition Column, the remainder of the field ambulances not detailed for the advance guard, that is all No. 1, Sections B, C, and D of No. 2, all No. 101, Sections C and D of 102 and all No. 103. There were also details comprising the supply and transport column. This main body reached Maneri at 3 p.m. While on the march, the A.D.M.S. counted and noted the suitability of all country carts met with either on the road or found in villages for supplementary sick transport. Twelve were noted on this day and, on the assumption that were it actual warfare only a fourth of these would be left, three were impressed and added to the columns to meet subsequent requirements.

At Maneri, the A.D.M.S. made a tour of all the bivouacs, received reports as to quality and quantity of water available and generally satisfied himself as to the arrangements. This was followed by a critical inspection of the village and adjacent buildings to determine how far local conditions would lend themselves to the organization and location of a post hospital. An excellent police thana was available, also a commodious civil officer's rest house. These were noted and appropriated as suitable adjuncts for the formation of a post hospital to be organized with two sections of field ambulances as an administrative nucleus. These steps were necessary as it was obvious that Maneri would in the course of the next few days play an important part as a connecting link or post with the Lines of Communication, whose head would be Hund after January 4. Orders were then issued that Section D of No. 1 and Section D of 101 Field Ambulance would remain at Maneri, open and establish a post hospital capable with local impressments of accommodating 150 casualties and sick. Only the tent divisions of these two sections were to remain; their bearer divisions were ordered to advance with the column when it moved off next morning.

During the evening, the G.O.C. received information that the enemy were holding the Jaffir pass and the Gelo pass and were also in some strength in a position between Gharai and Shahbazgarhi. Orders were issued at once that the advanced guard, then at Naudeh and hereafter referred to as the 1st Brigade, should march at 6 a.m. on January 3 via Jalal and Gulaman and get in contact

with the enemy holding the Jaffir position. The 2nd and 3rd Brigades or main body were to march to Naudeh at 7 a.m. January 3.

By 1.30 p.m., on January 3, the 2nd and 3rd Brigades with their associated units were at Naudeh. The G.O.C. received intelligence in the course of the afternoon that the 1st Brigade had come in contact with the enemy at Gulaman, a severe action had followed and that there were 207 wounded and 54 killed. The wounded were 65 British and 142 Indian; of the former 23 were serious, and of the latter 49 were serious cases. Some forty cases were classed as light. On being informed of these facts, the A.D.M.S. ordered the bearer company of No. 1 Field Ambulance to proceed at once to Jalal, halt there for the night and march at 5 a.m. and join the 1st Brigade column as soon as possible on the next morning. The A.D.M.S. next proceeded to make a critical inspection of the village and surroundings at Naudeh with a view to the formation and organization of a post ambulance. They were not so favourable as those at Maneri, there being only a comparatively small inspection bungalow but sufficient to aid materially the tent division of the field ambulances for the organization of shelter for from 150 to 200 casualties. The tent divisions of Sections A and B of both No. 1 and No. 101 Field Ambulance were accordingly ordered to open and, by making use of the P.W.D. bungalow, to organize and prepare for the reception of casualties. On the road and in the village 26 country carts had been noted as suitable for sick transport. Under war conditions only 5 were held as likely to be available. These with the three obtained on the previous day gave 8 country carts over and above the transport present with the bearer companies. Inquiries were made of the Transport Officer as to how many of his carts were proceeding back empty on the next day to refill at Maneri. He reported 22 carts leaving Gulaman on the following morning and 35 moving back from Naudeh. At the request of the A.D.M.S. orders were sent to Gulaman holding these 22 carts back until such time as the convoy of wounded could leave that post on the next day and placing them at the disposal of the S.M.O. of the 1st Brigade for evacuation of such sick and wounded as he could despatch on the following day. The A.D.M.S. wired to the S.M.O. 1st Brigade at 5 p.m. "No. 1 Bearer Company should report to you by 7 a.m. to-morrow. Stop. Evacuate as many casualties as you can to-morrow to Naudeh by No. 1 Bearer Company and 22 supply carts placed locally at your disposal. Stop. Evacuate remainder on following day. Report number and time of departure."

Practically no further intelligence was received by the G.O.C. The only news that came in was that the Gharai-Shahbazgarhi positions were still held by the enemy. Orders issued that evening directed that the 3rd Brigade, supported by a squadron of cavalry, a field battery and a company of sappers and miners, should march at 5 a.m. to Gharai *via* Yar Husain. To accompany this force the A.D.M.S. detailed Section B of No. 2 Field Ambulance, Sections C and D of No. 102 Field Ambulance and the whole bearer company of No. 101 Field Ambulance. The tent divisions of Section C of No.1 and No. 101 Field Ambulances were also ordered to accompany this force, but not to proceed farther than Yar Husain, where they were to remain until further orders, to act as a clearing hospital in the event of developments in front. These sections were timed to reach Yar Husain at noon, and the rest of the force to reach Gharai by 3 p.m. The 2nd or remaining Brigade with the other troops of the original main body was ordered to march at 6 a.m. to Gelo, being timed to arrive there at 9 a.m. The medical units accompanying this force were the tent and bearer divisions of Sections C and D of No. 2 and the whole of No. 103 Field Ambulances.

As the situation clearly indicated one if not two probable actions on the morrow at Gelo and Shahbazgarhi, the A.D.M.S. issued the following order to the S.M.Os. of the 2nd and 3rd Brigades: "Clear your field ambulances of all sick. Transfer them this evening to the post ambulance at Naudeh. All field ambulances must march to-morrow morning empty of sick." The result of this order was the transfer of 33 cases to the post ambulance. The S.M.O. at Naudeh was ordered to transfer these in the morning to Maneri, utilizing the empty transport carts leaving to refill at Maneri. This action left all the field ambulances with the brigades empty and also left the post ambulances at Naudeh empty to receive casualties evacuated from Gulaman. The A.D.M.S. also arranged for the despatch of the 8 empty country carts which had been impressed, to Gulaman with a convoy of supplies in 15 carts leaving for that place in the morning.

By 10 a.m. on January 4, the 2nd Brigade had arrived in front of the Gelo position, which was a small pass evidently strongly held. The G.O.C. gave orders for the attack. The A.D.M.S. satisfied himself that the location of the Sections C and D of No. 2 and the whole of No. 103 Field Ambulances were satisfactory and that they were open. Similarily, the disposition of collecting and dressing stations was arranged for. The attack developed slowly, and it was not till 4 p.m. that the position was carried and the pass secured.

The casualties reported were 43 killed and 101 wounded. Thirty-one of these were British and 70 Indian: of the former 11 were serious and 10 slight, of the latter 31 were serious and 15 slight. Owing to the difficulties of the ground, all of these 101 casualties could not be removed to the field ambulances until 7 p.m. The brigade bivouacked that night at Usai, all the casualties being taken over by No. 103 Field Ambulance. The two Sections C and D of No. 2 joined and bivouacked empty with the brigade at Usai, ready for any advance in the morning.

Events, during this day, had been occurring on our left, where the 3rd Brigade had come in contact with the enemy between Gharai and Shahbazgarhi, late in the afternoon. The action resulted in an evacuation of the latter place by the enemy, when the 3rd Brigade following up reached their bivouac at Bakhshali soon after dark. The casualties reported were 51 killed and 120 wounded, of these 55 were British and 64 Indian, 47 were said to be serious. All these casualties were reported to be in Section B of No. 2 and in Sections C and D of No. 102 Field Ambulances. These medical units were at Shahbazgarhi at 7 p.m. The brigade had gone on to its bivouac accompanied only by its regimental medical personnel and equipment, and the bearer divisions of Section B of No. 2 and of Sections C and D of No. 102 Field Ambulances. The A.D.M.S. visited and looked into the situation at Shahbazgarhi that evening; after inspection of the situation he wired the following order to the S.M.O. at Yar Husain: "Section C of No. 1 and 101 Field Ambulances to march at 4 a.m. to Shahbazgarhi and relieve Section B of No. 2 and the two sections of No. 102 by clearing. Stop. Report when relief completed." Another telegram was dispatched by A.D.M.S. in the name of G.O.C. to the I.G.C. at Hund to this effect: "Please relieve Maneri on 6th of casualties, also on following days." This was repeated to S.M.O. Maneri and supplemented by another telegram from the A.D.M.S. to the same officer at Maneri to the following effect: "Advise I.G.C. at Hund of your daily clearing requirements." This was repeated to the I.G.C. for his information.

In the meantime a telegram had been received from S.M.O. 1st Brigade to this effect: "85 casualties left for Naudeh at 10 a.m. of 4th. Stop. Remainder will be evacuated to-morrow by bearer divisions of A and B 102 and supplementary transport." This information was confirmed by the following telegram from S.M.O. at Naudeh to the A.D.M.S. Divisional Headquarters then at Usai: "85 casualties arrived from Gulaman. Stop. Similar number

expected to-morrow. Stop. Will evacuate first convoy to Maneri on 5th."

The situation, therefore, on the evening of January 4 was sufficiently serious to one acting as the A.D.M.S. of the division. Naudeh had 85 casualties from the 1st Brigade and would unload on Maneri on the morrow, also receiving the remainder of casualties from that brigade on the same day, probably not less than 90, even allowing that some had probably succumbed and some were sufficiently slight to be retained for treatment regimentally or in the field ambulance sections with the brigade. No. 103 Field Ambulance was practically full with 101 cases at Gelo and remained there. At Shahbazgarhi there were 120 casualties, which practically

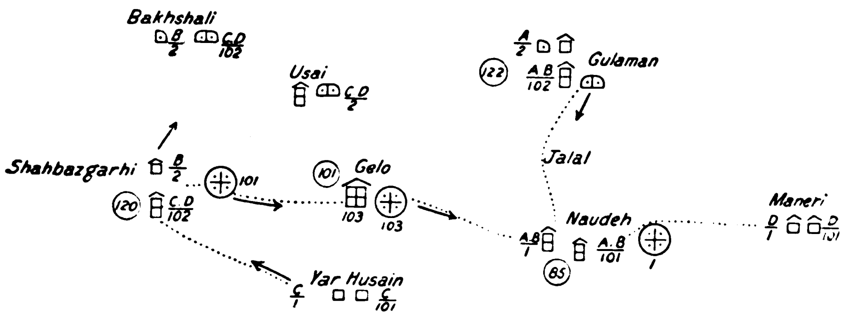


Fig. 2.—Situation of Medical Units on evening of January 4. Arrows indicate movement for next day. Ringed numbers show casualties.
means a complete Bearer Company.
means half a Bearer Company.

immobilized B Section of No. 2 and C and D of 102, until they could be cleared by the arrivals of Sections C of 1 and 101 from Yar Husain. The relief could hardly be expected to be carried out before 8 or 9 a.m. on the morrow. In the meantime, the 2nd and 3rd Brigades had joined and were bivouacking on the line Usai-Bakhshali. Orders were out for a further advance on the following morning at 6 a.m. towards Chagulai in pursuit of the enemy, who were reported to be concentrating and receiving reinforcements from Buner at some point between Chagulai and Rustam. These movements all indicated the likelihood of further casualties next day. The only redeeming feature was the absence of any news that the 1st Brigade had been further engaged or produced any more casualties.

At a conference held on the evening of January 4, under the Director of the Staff Ride, the whole situation was discussed in all its bearings. As A.D.M.S., the writer was called upon to express his appreciation of the situation, to explain the movements and disposition of all medical units on January 2, 3, and 4, and to outline his proposals. As explanatory of the movements and disposition of the medical units, diagrams, made up on the evening of each day, were handed in. Fig. 2 is the explanation of the situation of all the medical units on the evening of January 4. The appreciation of the situation was as stated in the preceding paragraph. As regards proposals for action, it was explained that two courses were possible: Either evacuate the casualties through Mardan and Naudeh, or only through the latter place. The former course would be possible only provided that the advance of the other divisions on Nowshera had been sufficiently successful to necessitate an evacuation by the enemy of Mardan. To this, the Director stated that Mardan could not be considered as yet unoccupied by the enemy, though certainly but weakly held. This decision, of course, ruled out any immediate chance of evacuating casualties in that direction. There remained then only to evacuate to Hund via Maneri, and the rapidity with which this could be done depended on the receiving capacity of Naudeh and Maneri; this was known to be at the outside 200 per diem at the one place and with difficulty 150 at the other. Therefore, any daily evacuation was limited to these numbers, if undue congestion at Maneri was to be avoided. The A.D.M.S., therefore, proposed only to evacuate 80 or 90 of the most pressing cases in the morning from Shahbazgarhi and Gelo into Naudeh on the 5th, which movement would entail this latter post receiving that day some 220 cases, namely, some 90 from Gulaman and 130 from Gelo and Shahbazgarhi. Inquiries made of the Transport Officer showed that 15 carts were available at the latter place returning empty.

To carry out these proposals, the A.D.M.S. issued the following order to the S.M.O. at Shahbazgarhi: "On arrival of Sections C of Nos. 1 and 101 Field Ambulances from Yar Husain, transfer all cases to them from C and D of No. 102. These cleared sections of No. 102 must proceed at once via Usai to rejoin the division at Chagulai. Sections C of Nos. 1 and 101 will stand fast at Shahbazgarhi until further orders, holding all cases from C and D of No. 102. The bearer company of No. 101 Field Ambulance should clear all cases from Section B of No. 2 Field Ambulance and with the aid of such empty transport carts necessary and available

transfer 80 of the cases now in Shahbazgarhi to Naudeh. Report numbers evacuated and remaining to both divisional headquarters and to Naudeh. On being cleared by No. 101 bearer company, Section B of No. 2 Field Ambulance must proceed at once via Usai to rejoin the division at Chagulai." This was dispatched by mounted orderly at 8 p.m., and received by 9.15 p.m.

At the same time, the following order was dispatched by A.D.M.S. to the S.M.O. at Gelo: "No. 103 Field Ambulance will stand fast at Gelo until further orders. By your bearer company send 50 cases to Naudeh. The company to return to Gelo same day. Report numbers remaining at Gelo after this movement." This order was despatched by mounted infantry and acknowledged by 10 p.m.

Early on the morning of January 5, the 2nd and 3rd Brigades with divisional headquarters advanced on Chagulai; with them were Sections C and D of No. 2 Field Ambulance only and their bearer divisions. Section B of No. 2 and Sections C and D of No. 102 Field Ambulance were not expected to join the division until 2 p.m. The 1st Brigade was reported as having occupied the Jaffir Pass on its evacuation by the enemy, and was now covering the Jaffir-Machai line in its advance to make a junction with the two other brigades. It reported no further casualties. At 11 a.m. the enemy was found to be holding a strong position near Hamzakot in front of Rustam, evidently having been much reinforced from Buner via the Ambeyla and Malandri Passes. Orders were issued for all three brigades to attack, communication having been established with the 1st Brigade. The medical units with that brigade were Section A of No. 2 and two tent divisions only of Sections A and B of No. 102 Field Ambulance. The A.D.M.S. having satisfied himself as to the best location and opening out of the Field Ambulance Tent Divisions, and the suitable placing of collecting and dressing stations, awaited developments.

At 2 p.m. the Director intimated that the attack had failed, and that the division must fall back and take up an entrenched position covering the Jaffir-Machai-Chagulai line. As the result of this morning's engagement, 44 were reported killed and 117 wounded, namely, 38 British and 79 Indian troops. A conference was held, and the G.O.C. directed to prepare a scheme for falling back and preparing an entrenched position. To the A.D.M.S. the task was given of showing how the existing casualties could be evacuated, assuming no further change in position of the division was made during the next thirty-six hours.

The A.D.M.S. made the following appreciation of the situation. There were 117 casualties and 21 sick in the field ambulances near Chagulai. Section B of No. 2 and Sections C and D of No. 102 Field Ambulances had joined the division at 3 p.m. All sick and wounded had been evacuated from Gulaman to the number of 179 out of the original 207 reported, 15 having died and 17 being sufficiently slight to return to duty, the others transferred being casual sick. At Gelo, the Officer Commanding No. 103 Field Ambulance reported 64 sick and wounded to be remaining. The S.M.O. at Shahbazgarhi reported 82 cases as sent to Naudeh by No. 101 Bearer Company and other transport, and that 55 cases were still remaining there in the tent divisions of Section C of

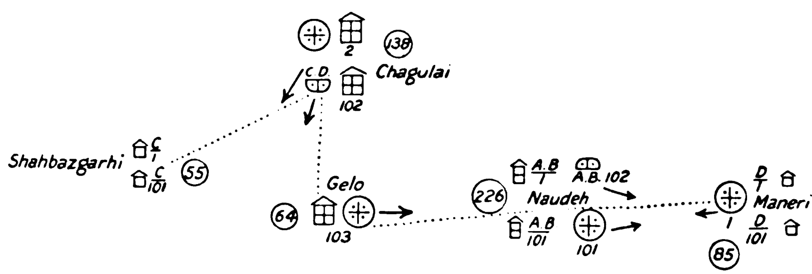


Fig. 3.—Situation of Medical Units on evening of January 5. The symbols are the same as in Fig. 2.

No. 1 and No. 101 Field Ambulances. At Naudeh there would be in the evening 226 cases, namely, 82 from Shahbazgarhi, 50 from Gelo, and 94 from Gulaman. At Maneri there would be 85 cases received during the day from Naudeh. These would be evacuated into Hund next morning. The situation of medical units on the evening of January 5 is shown in fig. 3.

To meet the situation, the A.D.M.S. asked the Transport Officer how many of his empty carts would be available at Shahbazgarhi, at Gelo, and with the division at 7 a.m. the following morning. The reply received was 12 carts at Shahbazgarhi, none at Gelo, but 25 moving down to refill from the Brigades. The A.D.M.S. then asked whether these carts from the brigades would move via Gulaman or via Shahbazgarhi. The reply was by the latter route as the road was better. He therefore issued the following order to the Officer Commanding No. 103 Field Ambulance at Gelo: "By your bearer company transfer 50 cases from Gelo to Naudeh to-morrow morning. Report number evacuated to divisional

headquarters and to Naudeh. Be prepared to receive 80 fresh cases to-morrow." This was dispatched by field telegraph. To the S.M.O. at Shahbazgarhi: "Twelve transport carts are at disposal of your post; 15 others will be at your disposal from headquarters by 9 a.m. to-morrow morning. By carts evacuate all your cases to Naudeh to-morrow. Be prepared to receive 60 cases to-morrow from the brigades. Report departure of cases to divisional headquarters and to Naudeh." This was dispatched by field wire. To the S.M.O. of 1st, 2nd, and 3rd Brigades the following order was given: "Two ambulance columns will leave at 7 a.m., January 6, for Shahbazgarhi and Gelo. No. 1 column for Shahbazgarhi will consist of the bearer divisions of Sections A and B of No. 2 Field Ambulance, and 15 carts available from the Supply Column. No. 2 Column for Gelo will consist of the bearer divisions of Sections C and D of No. 2 and Sections C and D of No. 102 Field Ambulances, and 10 carts available from the supply column. The S.M.O. of 1st Brigade will detail a Major, R.A.M.C., and a Captain, I.M.S., together with an Assistant Surgeon and Sub-Assistant Surgeon for command and duty with No. 1 Column. The S.M.O. of 2nd Brigade will detail a Major, I.M.S., and a Captain, R.A.M.C., an Assistant Surgeon and Sub-Assistant Surgeon for command and duty with No. 2 Column. Officers detailed for respective commands of these ambulance columns will arrange for point of assembly and collection of transport and loading up of their columns in consultation with S.M.Os. of brigades. Each S.M.O. of a brigade to see that his field ambulances are cleared of all sick and wounded. Only slight cases likely to recover in a few days are to be held back. S.M.Os. of brigades will report to A.D.M.S. numbers evacuated from and numbers remaining in their field ambulances. The Officer Commanding No. 1 Ambulance Column will transfer his casualties to the S.M.O. at Shahbazgarhi, and then return with his medical personnel and bearer division, less supply carts, to divisional headquarters. The Officer Commanding No. 2 Ambulance Column will transfer his casualties to the Officer Commanding No. 103 Field Ambulance at Gelo, and then return with his medical personnel and bearer division, less supply carts, to divisional headquarters." A copy of this order was repeated to Gelo and Shahbazgarhi. To the S.M.O. at Naudeh the following order was telegraphed: "No. 1 Bearer Company will arrive empty from Maneri on 6th, use it with supplementary empty supply carts to evacuate at least 130 cases to Maneri on 7th. No. 103 Bearer Company will arrive from Gelo and Shahbazgarhi

on 6th. Order it to return that evening to Shahbazgarhi for further evacuation of cases on 7th. The bearer division of Sections A and B of No. 102 Field Ambulance will arrive empty from Maneri on 7th. It should proceed in early morning of 8th to Gelo, and be placed at disposal of Commanding Officer No. 103 Field Ambulance for return that day to Naudeh with such casualties as he may be able to evacuate that day; assuming no other orders for its movements are issued subsequently."

These arrangements would ensure the complete clearing of all advanced field ambulances of their sick and casualties by the morning of January 6. Their bearer divisions, except those of A and B of No. 102, would have rejoined them by the evening of the 6th, as the distances were only eight and seven miles each way.

The situation, therefore, on evening of January 6, would be as follows: field ambulances with the divisional headquarters practically empty. At Shahbazgarhi some 60 cases. At Gelo some 100 cases. At Naudeh, assuming that 130 cases had been sent on to Maneri on 6th, there would be 181 cases: while Maneri would be holding 130 cases. On 7th, Sections C of No. 1 and No. 101 Field Ambulances could and would be cleared, enabling them either to fall back on Gelo or Naudeh and relieve the congestion there, or be moved elsewhere if the military situation changed.

The above solution of the medical problem was submitted as meeting the circumstances. It is not held to be ideal or, perhaps, incapable of improvement. One weakness is in the fact that Sections A and B of No. 102 Field Ambulance, which originally accompanied the 1st Brigade, are without their bearer divisions, and certainly must remain so until the 8th. It was difficult to avoid this, as the numbers of casualties produced in the three days' fighting were so heavy, and the obvious need to clear the ambulances at the front as much and as quickly as possible necessitated their utilization as part of the evacuating ambulance column. The situations occurring on this Staff Ride are neither unreasonable nor improbable. They clearly show that with a division operating by itself and loaded with some 600 casualties within three days at least half of the medical units allowed to a division will need to be employed as links in the chain of the line of evacuation. In this particular case, only two field ambulances with their bearer companies were ear-marked originally for this duty. As events turned out, it will be seen that the tent divisions of these field ambulances, namely, those of No. 1, No. 101 and No. 103, have been utilized in the later phases for clearing work, and that three and a half bearer

companies, or those of No. 1, No. 101, No. 103, and half of No. 102, have had to be employed as ambulance columns.

A further doubt presents itself as to the solution made. It is whether both ambulance columns detailed to proceed on January 6 from the brigades to Gelo and Shahbazgarhi should have been ordered to rejoin that evening at divisional headquarters. In the absence of any instructions that a retirement was contemplated, it is held that such action was right, particularly as an advance was not out of the question. On the other hand, had there been any indication of a retirement on January 7, then the retention of one ambulance column at either Gelo or Shahbazgarhi would have been a necessity.

In submitting these details and analysis of this particular Staff Ride, one is fully conscious of its imperfections. Still, as an attempt to give a sequential narrative, with details, appreciations and copies of orders issued, it may be of help to others as a guide what to do or what not to do, should they find themselves in similar circumstances. One thing must never be omitted. That is the need to keep simple but frequent notes of the position and condition of the various medical units under control. These must be made up accurately each evening. What form they take is best left to the individual. The system of graphics explained by Colonel Macpherson is quite workable and effective. If the movements are complex, one's experience suggests their being drawn on a large scale. Personally, one has found a series of skeletal maps, such as shown in figs. 2 and 3, quite enough and giving a better mental picture of the situation. But, as already said, these are details as to method about which each man should think for himself. The essential thing is to be alive to the facts through every hour of the day, and be able to answer correctly any question arising as to the position and condition of each medical unit at any time. An A.D.M.S. able to do this attracts the confidence and respect of his G.O.C. and is, himself, free from all doubt or worry as to what to do, should unforeseen circumstances arise. As a matter of fact, assuming that the A.D.M.S. is a live A.D.M.S., there should be few contingencies which he has not foreseen.

REGIMENTAL STRETCHER-BEARERS.

By G. FAHEY.
Late 88th Connaught Rangers.

THE method usually employed in my time for providing regimental stretcher-bearers was to select haphazard, at the commencement of the annual drill season, a number of men to act as bearers for the year. These were trained under the supervision of the station medical officer, and instructed in the placing and carrying of men on stretchers, a few methods of carrying by hand, and the rudiments of first aid.

Bandsmen, who invariably undertake the duties of stretcher-bearers in the field were rarely, if ever, instructed; this no doubt being the outcome of a desire not to interfere with their musical duties.

For certain reasons, however, I am of opinion that bandsmen are the men who should be trained in peace and utilized in war as stretcher-bearers. Bandsmen are usually long service men, remaining in the battalion to which they are posted. They pride themselves on having more intelligence than the average ranker, and the study of music should conduce to the calm tending of wounded.

One objection to the employment of bandsmen is that many enlisted as boys do not develop a high enough standard of height and physical efficiency for the work of carrying wounded. Strength, however, does not always accompany inches, and as quickness and agility are required as well as strength for the safe removal of wounded on a modern battlefield, a special course of physical training, devised with a view to fitting the men for carrying by hand and stretcher, would compensate for lack of inches.

Instead of the slow movements with a stretcher, performed with automatic regularity and precision on the barrack square, and a few examples of hand carrying which at one time was the sole instruction given, the regimental bearers should be practised in the quick as well as careful removal of wounded by hand and by stretcher, over obstacles and in rocky, hilly country.

The quick removal of wounded from exposed positions to places of cover with the minimum amount of pain and inconvenience to the patient is more important than dressing and bandaging. Every soldier should be taught first aid so as to be able to dress himself when possible, or bandage his nearest comrade who may be

wounded, as very often the bearers may not be able to reach him, owing to the intensity of the fire.

The training of a regimental stretcher-bearer might be continuous throughout the year, that is, when he has passed through a certain course, he should be exercised at least once a week, and should not consider himself as thoroughly efficient until, besides being familiar with the other duties of a bearer, he is able to remove a man of average weight single-handed a certain distance in a stipulated time. When engaged on manœuvres the instruments of the band might on arrival at the manœuvre area be put on one side and the men employed as stretcher-bearers till the conclusion of the operations.

During the manœuvres, opportunities should be given to the bearers to practise the duties they would have to perform in actual war. They should follow behind their brigade or regiment, select their own aid-posts, dress and remove men detailed to represent wounded, carrying them to places of cover, or to the ambulance wagons. They should work distinct from the ordinary bearer companies, handing their wounded over to these companies when necessary, but never working in conjunction with them, always bearing in mind that their place when not actually engaged in removing wounded is with their regiment or brigade.

A special equipment might be designed for stretcher-bearers. Instead of the usual straps and belts a double haversack suspended from both shoulders should be worn. The suspending sashes should have a few small pockets, in which some bandages and a pair of scissors might be carried, the scissors for cutting open clothing. In the haversacks the bearers could carry their personal kit, the whole being made to slip on and off easily. A large red cross armlet should also be worn.[1]

In the early operations in Natal, during the South African campaign, the regimental stretcher-bearers were sent into action with small armlets bearing the letters S.B., and the bandsmen wearing their old Roman swords. Some of these bearers, falling into the hands of the enemy, were promptly made prisoners, the Boers not understanding the mystic letters, and entertaining strict notions of their own as to the arming of non-combatants.

As a sequence to this, we were ordered to hand in our swords, and cover the offending letters with a red cross. The only red

[1] [Note.—Under the terms of the Geneva Convention, 1906, our regimental stretcher-bearers are not entitled to wear the Red Cross brassard.—Ed.]

cloth available at the time was the badge on our helmets. With this, and a piece of puggarie from the same, we made red cross badges to cover the old S.B. armlet. These small badges, which it would have taken powerful glasses to discern at even a short distance, were what we would have worn on our arms throughout the Natal campaign but for the fact that whilst engaged in the task of removing the dead from Hart's Hill during an armistice the Boer ambulance men considerately gave broad red cross armlets to some of our men.

As a regimental stretcher-bearer would in civilized warfare be treated as a non-combatant, he might be exempt from part of his musketry course, and the time thus saved be devoted to ambulance training. In savage warfare he might be armed with an automatic pistol.

Should it be the luck of the trained regimental stretcher-bearer to take part in a big campaign he will, provided he is possessed of a fair amount of intelligence and resource, find the work to be of a most interesting nature. He will have opportunities, denied to his comrade in the ranks, of seeing various phases and incidents of the operations. In carrying wounded from the firing line and in returning he sees the movements of troops, occasionally overhearing orders given by the generals. If he is discreet, he will not talk about these matters, and so get into the habit of talking carelessly or absent-mindedly about important matters, the danger of which I may best illustrate by an actual occurrence.

It was during the short armistice, two days after the attack of the Irish Brigade at Hart's Hill. I was engaged with the remainder of the bearers in removing the dead towards our lines for burial. Only red cross men of either side were permitted between the lines where the dead lay, and we took the opportunity to converse with the Boer ambulance men. Before any conversation had commenced between us, however, one of our own men whilst passing us with a stretcher remarked, at the same time pointing to a lofty hill towering above the Tugela :—

"There will be a queer slaughter here in a few days; Buller is getting all the guns up there."

I knew this to be true, as I had seen the movements of the guns, and it would have been most valuable information had it been overheard by one of the Boer ambulance men, but fortunately there were none near us at the time. I cautioned the man, telling him to be careful and not to talk about such matters there.

When engaged on manœuvres, or on service, the bearer should

exercise his faculty of observation. He will find that during the course of the operations he will at times become isolated from his regiment. Of the four men detailed for his stretcher party, two may become separated from the stretcher whilst removing wounded by hand. He will thus find himself with only one man, with, perhaps, darkness setting in.

It will be well, therefore, when following his regiment to the attack, to take a careful mental note of objects such as clusters of trees, houses, paths or tracks across country; or, if in hilly or mountainous country, clusters of rocks, large boulders, or any peculiar formation of the landscape. This will be useful to him when finding his way to and from his regiment. It might be well also to note spots sheltered from fire, where he may rest when bringing down wounded. Such places may also serve as collecting stations, to which he may remove wounded from exposed positions, bandaging and leaving them till the bearer companies come along.

Very often the dressing stations selected by the medical officer attached to the regiment are placed too far back, so that carrying one man there takes a long time. It is better to bring several men to sheltered spots near at hand where they may be left in safety than to spend a long time carrying one man a great distance to be attended to.

If there is drinking water in the line of advance, he should fill the water-bottle at every opportunity, as the wounded will usually be found clamouring for water. When possible wash the hands also, as it is most important when dressing a wound that the hands should be clean. It is impossible at times to keep the hands clean during an action, and where numbers of wounded have to be attended to the hands of the bearers get into a very dirty condition. Perhaps a pair of antiseptic gloves might be carried by each bearer, to be used only when dressing wounded. These might be kept in a sealed packet, to be opened when going into action.

A number of the wounded will invariably be found with their field dressing packets missing, which is the reason I suggest the carriage by the bearers of a few bandages. If prolonged operations have been in progress entailing much crawling through rocks, hedges, or barbed wire, the clothing gets torn or worn, allowing the package to drop. Again, the men found out during the South African War that the bandage roll was an excellent material for lighting pipes with when matches were scarce, or, as in the case of holding a position near the enemy when no lights were allowed at night, the bandage roll could be passed smouldering from hand

to hand. Our bearers anticipating this at Hart's Hill, where the Brigade lost so heavily, filled their haversacks with bandage rolls from an abandoned Boer ambulance wagon. I have one of these bandage rolls by me to-day as a souvenir.

It will at times be found more convenient to remove all but very dangerous cases by hand than by stretcher when the distance to cover is not great. In hill fighting, where there is usually more cover in the shape of boulders or shallow ravines, this method will be the quickest.

In a long advance over a plain where cover is absent, the wounded may have to be carried a long distance to be handed over to the bearer companies or placed on the ambulance wagons. This was the method we employed at Colenso, where cover was scarce.

In a modern battle much entrenching would probably be resorted to in the advance. The regimental stretcher-bearer's work in this event would be to bring back the wounded to the trenches after each successive rush. In this work also removal by hand might be employed with advantage.

When removing wounded to cover during an advance, whilst the artillery are shelling the enemy's position, if the bearers listen for the passage of the shells above their heads, they may take advantage of the lull in the enemy's rifle fire that may occur whilst the shells are bursting, to remove the wounded to cover.

In bringing wounded down from Hart's Hill I found this a safe method for crossing points at which the bullets, directed at the men above, were dropping fast. To cross some of these points with a man on a stretcher would be attended with great risk. The way, however, was dotted with large boulders and rocks, and as our artillery were firing salvoes at the time, we listened for the passage of the shells, and quickly removed our man across the danger zone during the lull in the firing that followed.

I adopted a similar method when bringing a man in from the front of the firing line during the same operations. The stretcher-bearers of my regiment were directed to endeavour to bring in some wounded who had been lying on the ground abandoned the previous evening. My stretcher party being the first to make the attempt, I suggested to the other three men how we should proceed. Knowing that with the tension existing between the two forces at the time, and the short distance separating them, any attempt to cross into the intervening space in force would draw the concentrated fire of the enemy towards us, I stated my idea. On reaching the extreme line we would wait behind the sangar for the passage of

our shells, cross over and separate to right and left till we found a man. We followed this plan of crossing the sangar whilst our shells were bursting and brought in a man. The enemy seeing our mission evidently refrained from firing at us, as I anticipated they would once we had crossed the sangar, for though five more stretcher parties crossed only one man was hit, and he, perhaps, by a stray bullet.

Sometimes wounded may have to be searched for and collected at night. As it is not always desirable to carry lanterns, and thus convey an idea of the position of the forces to the enemy, the bearers should accustom themselves to working in the dark, and without noise. The latter is important when collecting wounded from the front of the lines at night. The search parties should spread out as much as possible, two men on each side of the stretcher, who should carry sticks to feel their way. They should keep their ears alert for sounds of moaning, or cries of wounded. Those that are not very dangerously wounded usually keep up a constant noise at night, and are more easily found, but bad cases are generally silent, or else emit a low moaning sound.

As the wounded are picked up, they should, if in front of the lines, be all collected in the centre of the search line, one or two men being left with them till the search party have satisfied themselves that no more wounded are in the vicinity, when they may be all brought back to the lines.

In returning, the two men of each stretcher party not actually engaged in carrying the stretcher or assisting men by hand, should walk in front of the stretcher to search for obstacles or holes in the ground, and thus save the bearers behind from falling with their patient.

The bearers will find a stick useful for night work. In South Africa we usually carried sticks on the march, handing them over when relieving each other to carry the stretcher. I have thought since that two strong staves similar to those carried by the boy scouts might be useful both for feeling the way at night and for making an improvised stretcher with the aid of the men's putties when necessary. A staff each might be carried by the two men not actually carrying the stretcher, a small red cross flag might also be useful for fixing on one of the staves, when bringing in wounded from the front of the lines.

The duties of a regimental stretcher-bearer do not consist exclusively in the removal of wounded from the battlefield. As I have shown, he may be called upon to assist in the removal and

burial of the dead. He will also be required to carry the sick from the regimental hospital tent to the field hospital, sometimes a distance of a few miles.

This of course merely requires strength, though occasionally steadiness and nerve may be necessary. At Fourteen Streams, during our advance to Mafeking, the railway bridge over the Vaal river having been blown up, a deviation of the line was made and brought over what evidently was once an old road bridge. Planks were placed between the old supports, whilst the bridge was being temporarily reconstructed. Over these planks we had to carry the sick on stretchers; if one man stumbled the whole three together with the stretcher must have fallen into the water beneath.

Sometimes there is a humorous side to the regimental stretcher-bearer's experiences. After the Relief of Ladysmith the field hospital having been pitched in a somewhat swampy position, it was decided to remove it. The stretcher-bearers of the different regiments were required to attend and assist in the removal. The patients were detailed for carriage according to the character of their injury or illness, the worst cases being detailed for stretchers. A patient was pointed out to us for my stretcher, but as soon as we approached him to place him on the stretcher he loudly protested, stating that he could walk, and that some mistake had been made about him. We appealed to one of the hospital orderlies for instruction and were told that he would have to go on the stretcher as he had been detailed for one. By dint of persuasion and a little force, we managed to get him on the stretcher, and carried him whilst he protested in choice language the whole distance. Personally I think a mistake had been made, as he was about the healthiest looking patient it has been my lot to carry.

The bearers must go with the company they are attached to when that company is for outpost duty. Not being, however, required for sentry duty, they are usually permitted to sleep behind the men who are awaiting their turn for sentry. When selecting a position for sleeping so as to be within call when necessary, it will be well if the whole stretcher party are to sleep, to guard against the possibility of being left on the field when the outposts retire in the morning, an event I had a personal experience of. On the evening following the capture of Vaal Krantz, my company was sent, just after nightfall, to occupy the lower ridges of the hill facing the enemy's position. On arrival there and when the outposts had been placed, I selected a spot at the bottom of a ravine, on each side of which a sentry had been

posted. There were only two of us with the stretcher at the time, and neither had had any sleep for several nights; despite the incessant firing the enemy kept up throughout the night, we were soon fast asleep. We had taken precautions to warn the sentries of our position should we be required, and also to wake us when the outposts were about to be withdrawn. The sentries had evidently forgotten to pass this on when relieved, for awakening just before daybreak I missed the sentries on each side of the ravine. I managed to hail the last man, who told me they were going "home." By the time I had got back and awakened the other man we had missed the direction the company had taken. We, therefore, had to find our way back to where we had left the regiment the previous evening by the way we had come. We reached the regiment, which was lining the banks of the Tugela some time before our company, to do which we must have passed right under the noses of the enemy in the light of the breaking day.

It may be made part of the regimental bearer's duties to direct unwounded stragglers back to the firing line. During the progress of an action the bearers should reject all offers of assistance proffered by armed stragglers. Unless these men have been ordered by someone in authority to assist, they should be directed back to their regiment.

United Services Medical Society.

REGIMENTAL AND FIELD AMBULANCE TRAINING IN THE TERRITORIAL FORCE.

By Major JOSIAH OLDFIELD.
Royal Army Medical Corps (T.F.).

In comparing the training of R.A.M.C.(T.F.) officers attached to infantry units with that of officers forming part of a T.F. field ambulance, it is necessary in the first place to see exactly what minimum the regulations demand, and then afterwards to consider how these regulations work out in actual practice. Let me take the infantry regimental medical officer first. Appendix VII (6), Territorial Force Regulations, is as follows:—

"Officers attached to combatant units: The annual training in camp the first year, or an appropriate course of instruction in a R.A.M.C.(T.F.) school or selected military institution (eight days in each case)"; and in subsequent years the "annual training in camp"; and finally, before promotion to the rank of major, a course at a R.A.M.C.(T.F.) school or selected military institution (eight days).

Now if we inquire what this means we find that from the time of joining the Territorial Force a regimental medical officer may remain for years on the strength and yet never do a single day's duty for his battalion, or come into contact with any of its officers or men during their training, or get a single day's practice with his battalion at the work he is supposed to be trained to do for it in time of need.

It is true that the regulations state that it is during the first year that the alternative course may be taken in place of camp, and on the face of it it would appear that the subsequent years' annual training must be in camp, but the context shows that not only is the alternative course to camp optional every year, but further regulations show that when a combatant unit is at its full strength only one of the two medical officers is allowed for in the annual camp training, and therefore, while the minimum is no camp training at all, the maximum is only fifteen days every alternate year. There are few of us who go to camp fairly regularly but feel that, in order to keep in real touch with actual practical duties, officers

ought to spend at least a month every year, instead of a fortnight, in contact with the men of their own battalion and their work, and therefore a maximum of a fortnight every two years is certainly not enough to render a man efficient. Officers ought to know exactly and at once what to do upon mobilization, if the Territorial organization is meant as a real war machine.

It is specially important to notice that a field ambulance officer is obliged to attend a camp once in three years, and this is expressly laid down as the minimum, with the implied suggestion that he should attend camp oftener.

I emphasize this point again because I look upon an efficient camp training as the only real way in which a medical officer can be fitted for active service duties. The point, therefore, is that stress is laid upon the fact that an infantry regimental medical officer cannot attend camp more than once in every two years, whereas the obligation is laid upon a field ambulance medical officer to attend camp not less than once in three years. In a system which depends so greatly upon the spirit of voluntaryism and enthusiasm it is of the greatest importance to notice wherein men are encouraged to be keen, and wherein they are repressed from being too keen. I find it a little difficult to contemplate any combatant unit being able to get a couple of keen medical officers, who know that they would be unable to go to camp more than once in two years. The palpable answer is that it is not easy to get one good man to join a regiment, and less easy to get him into camp for a fortnight every year, so that this provision of two officers with alternate year's service is for the purpose of making it sufficiently easy to induce busy practitioners to join. While this may be the argument upon which the regulations were framed, the practical result has proved that in the Territorial Force it is easier to get an equally busy practitioner to go into camp year after year for the full fortnight than it is to get a full complement of regimental medical officers to go into camp for alternate years. The mere fact, therefore, of "making it easy" is not the inducement which attracts men to join the Territorial Force.

What training does a regimental medical officer get during the year that he does not attend camp?

The regulations stipulate for none, and unless the medical officer takes the initiative upon himself there is practically nothing that he is definitely put to do the whole year through. One may, therefore, well ask oneself in what way is a regimental medical officer being trained in time of peace to perform his duties in time of war?

I am quite aware that an objection may be taken to my statement upon the following grounds :—

(1) The A.D.M.S. is responsible for all the R.A.M.C. in his division, and therefore he is responsible for taking steps to secure that all the regimental medical officers in his division are being trained, so far as the regulations allow him to put pressure upon them.

(2) The examinations in "A" and "B" have to be passed before promotion to the rank of captain, i.e., during the three and a half years after an officer joins.

(3) Para. 363, Territorial Force, which directs that "in every unit a sufficient number of men will be trained to supply . . . stretcher-bearers." Para. 364: "The men should be trained, as far as possible, during the drills performed throughout the year, so as to be able to carry them out during their annual training in camp."

Para. 372: "Classes for instruction in stretcher exercises, as laid down in the King's Regulations, will be held under regimental arrangements for the purpose of training the stretcher-bearers required by the Territorial Force establishments, and such others as it may be thought desirable to train in this duty."

These three headings suggest, indeed, that a regimental medical officer may have some work to do for his battalion during the twelve months, but the link between the officer and these duties is so shadowy that unless there is a very keen A.D.M.S., who has a very full grounding and experience himself in camp duties and in active field training, he will not worry the regimental medical officers in his divisional area, and from the information I have been able to gather, many regimental medical officers hardly know of the existence of their A.D.M.S. beyond his name. The training of stretcher-bearers is a very difficult thing, as only two per company are allowed, and the medical officer, being generally in the neighbourhood of one of the company headquarters, has only two men conveniently near to train, excepting at battalion drill.

At battalion drill, on the other hand, the O.C. wants every man in the ranks to make up his numbers, unless he uses his band for advertisement purposes, and then the band resent being asked to play on the march and drill on the field as well.

While then, on paper, the regimental medical officer has plenty of work available during the year, my experience leads me to say that in practice it works out that he has very little training in the duties that will be required of him on mobilization.

The question of examination is perhaps the most important one

that faces him, for every officer expects to pass within the time allowed; but when one realizes the fact that he is allowed three and a half years in which to prepare for "A" and "B" examinations, and that he generally puts them off until towards the end of the time, it follows that these examinations—valuable as they are—are hardly a fair criterion as to whether a man can join his battalion on mobilization and take up the important duties that he then has to do.

Now what are the duties that a regimental medical officer is expected to do?

It is often and fallaciously supposed that a regimental medical officer's only duties are to attend to the sick of his unit in times of peace, and between engagements, and to look after the wounded during the battle. The plan of the Territorial Army is, however, built upon a very different scheme. He is expected to be the pivot of knowledge and supervision upon which the health of his unit depends. He is the right-hand man of the O.C. of the unit upon all questions which make for the health of the men and prevent disease amongst them; he is responsible for the medical and surgical stores within the allowance; he is responsible for the proper discharge of their duties by the R.A.M.C. attached to the unit; he has to see the sick, to know all about the routine of dealing with infectious cases, accidents slight and serious, and men partially fit and unfit for camp training; he has to deal with first aid treatments in engagements and to train his staff how to treat them and how rapidly to pass them on to the field ambulance; he has to have some knowledge of securing cover for his wounded, of selecting sites for aid-posts, of correctly reading, understanding and transmitting orders, of appreciating landmarks, of map reading, of judging time and distance, and the meaning of punctuality where margins are very fluctuating; and finally, but not least, he must find his bandsmen and get them to drill.

When we compare these duties with the training the regimental medical officer is required to undertake to prepare for them, we can understand where a failure would occur when the machine is actually tested.

I have sketched something of the training of the regimental medical officer, and also of his duties, and I ask myself what inducements and incentives are held out to a regimental medical officer to go beyond his minimum and to develop into that most effective wheel in the organization which is contemplated in the Army framework? What pressure of example or *esprit de corps* or

sense of duty or other force will bear upon him to cause a regimental medical officer to become the officer which the battalion wants if it is going to work on the best lines in peace and be best worked in time of war?

I look round and feel that most of those forces which go to make field ambulance officers keen about their work are absent from the lives of regimental medical officers.

I can quite see how keen men tend to become apathetic, how men who want to work hard tend to let things slide, and how a regimental medical officer tends to become nothing more than a name in his battalion.

What then are the forces which are present or absent for a regimental medical officer as opposed to a field ambulance officer?

I think that the most important of all is that a regimental medical officer is, in his battalion, a stranger without trained knowledge.

He is a stranger, because all his fellow officers have common training, common duties, common topics of professional interest; he has no part in their training or duties.

He is without trained knowledge of his own duties, because, before a man can know how to treat a machine, he must understand the machine and its method of working.

Put a doctor into camp for the first time and the camp is actually over before he has grasped much of how the machine works. A camp is run largely upon a skeleton basis of old Army men, all the camp arrangements are fixed up largely before the battalion marches on to the ground, and the regimental medical officer has neither time nor opportunity to learn all about them.

Since he has no trained knowledge he does not know when to assert himself and when not to do so, and not infrequently the keen man gets snubbed into apathy because he either meddles at the wrong time or the wrong place, or with the wrong person or with the wrong thing.

Some permanent officials of a camp may think it easier to work without a trained medical officer, and therefore he may be encouraged to expend his energies on stretcher drill and seeing the sick, rather than on examining tents and lines, canteens and cookhouses, and putting stress on that pioneer form of drudgery which men naturally like to shirk.

To a man who knows his duties, and how to perform them, and can quote authority for his requisitions, there are none more ready

to render assistance than the serjeant-major and the quartermaster, but they are not in camp to *teach* a medical officer his duties, and they have quite enough work to do without being hampered by an incompetent medical officer, and therefore an untrained medical officer is gently eased off again towards his strictly medical duties, which worry no one.

Another reason is the want of the stimulus of example and *esprit de corps.*

In a field ambulance man vies with man, every officer works in the public light of fellow officers, superior and inferior, and in the public view of some 200 men who are capable of criticizing; but in many battalions hardly anyone knows what the medical officer's real value is, and all that they ask is that he shall be there if a man falls out sick or an accident happens.

Regimentally the O.C. is responsible that the duties of the medical officer are carried out, but in actual practice the O.C. is far too busy with training the officers whose duties he does understand to allow him time—even if he had the inclination or the knowledge—to look after the training of the medical officer himself.

In the field ambulance, on the other hand, the O.C. is a doctor amongst doctors, he is as keen on training his junior officers, and having them smart and keen and efficient, as the combatant O.C. is to make his combatant officers the best possible.

The regimental medical officer inherits the position of the old volunteer medical officer, who was much sought after when his services were required, but who was a nondescript on parade.

The Territorial Force Regulations give a position and status to the regimental medical officer, and with them come increased efficiency; but if you put the old volunteer medical officer into khaki and mount him on a horse, he does not thereby become a Territorial regimental officer of the R.A.M.C. To fit him for his new responsibilities and to enable him to take them up in a battalion which still retains many of the old traditions, he needs—of all men—special training, and to be specially up in his duties and authorities. The field ambulance officer must do thirty drills in his first year, the regimental medical officer need not do any. The field ambulance officer must do fifteen drills every year before he goes into camp, the regimental medical officer need not do any. The field ambulance officer must go into camp at least once in three years, the regimental medical officer need not go into camp at all. The field ambulance medical officer must obtain a riding certificate, the regimental medical officer is allowed a horse, but need not know

how to ride it. This shows at a glance how a field ambulance medical officer is trained, so that he can understand his camp when he arrives and know something of the men he will lead, whereas the regimental medical officer is dropped into a new world with his professional training his only qualification; no wonder, therefore, that a regimental medical officer tends to remain simply a camp doctor. It follows from this that the applications for commissions for regimental medical officers will necessarily be fewer, and that the present difficulty in getting them will be accentuated rather than diminished. A barrister or a solicitor or an architect or a banker takes a combatant commission, and when he goes into camp he throws off all his previous worries and nerve strain, and with zeal takes up a fortnight's outdoor life of strenuous exercise with everything speaking of a change and holiday. A doctor, on the other hand, leaves his daily round of consulting-room and sick-room, and the sorrows of the ailing and the groans of those in pain, and finds that his regimental camp work is very much the same. If, however, he joins the field ambulance he gets a delightful change—some hospital work, but a much larger amount of open-air exercise, drilling, teaching, inspecting, advising, horse-riding, the selecting and pitching of camp, and the responsible control and administration of batches of men, and a position of weight and dignity as belonging to an important and integral part of the division. The fact that a regimental medical officer cannot rise beyond the rank of major is apparently a harmless and necessary regulation, but its effect, so far as it goes, is to reduce enthusiasm, and, in the presence of the time-limit of retirement, it does not seem to be necessary, when combatant officers may rise to the rank of lieutenant-colonel, although they do not command the battalion. The regulation reads: "An officer of the Corps posted to a regimental unit will not, whilst so attached, be eligible for promotion in the Corps above the rank of Major." This suggests that a regimental medical officer could rise to the rank of major and then transfer to a field ambulance, and therein rise to the rank of lieutenant-colonel or colonel; but in practice this would not work out so, because no field ambulance would be likely to agree to accept an outside major who would step over the heads of all the captains and subalterns and block their own promotion. Para. 104 gives the methods of procedure in case of transfer, but experience proves that once a regimental medical officer attains the rank of captain he would find a difficulty in getting transferred to a field ambulance because of this question of seniority.

Side by side with this inability to rise beyond the rank of major, however capable he may be, comes the fact that the regimental medical officer is debarred by want of experience in the handling of men. For the combatant officer there is the rule laid down that the O.C. shall give him opportunities of taking command when he attains higher rank, and the same holds good in a field ambulance; but a regimental medical officer lacks that incentive to enthusiasm—the possibility of one day himself being in command where he now serves and obeys. If a man is only to be a doctor to his battalion, then in the presence of the modern spirit, that paid service is better than voluntary service, he will expect to be paid a very much higher rate of pay than the combatant officers, to whom their work is that change of occupation which constitutes the best of holidays. There is another point which I feel bound to mention. Para. 382 provides for the attachment of an officer for a period not exceeding twenty-four days to a regular unit. I can only conjecture from my experience that such an important training would appeal more to the field ambulance officer than to the regimental medical officer, and I hope that some of the members present may be able to give statistics on this matter.

I have been led to write this paper because I have been first a regimental medical officer, second a field ambulance medical officer, and since my years of training in each I have gone back for part of my own camp to do duty as regimental medical officer. Going back to my old post, as it were, I was able to gauge what the field ambulance had taught me—to see how it was that as a regimental medical officer I had gone about with eyes not seeing and with ears not hearing, and with much enthusiasm but little training. I venture to suggest that the objections incident to the regimental medical officer's want of training should be got over as follows:—

(1) That there should be no regimental medical officer's training as such.

(2) That the one portal of training should be the field ambulance.

(3) That from the field ambulance officers should volunteer for regimental duties not earlier than the close of their first year's training and fifteen days camp.

(4) That a regimental medical officer should not be debarred from an annual camp, but should be encouraged to go, and if there are two medical officers to any battalion, that one should be attached to the field ambulance from his camp and the other to his

regiment. If the field ambulance became the "feeding ground" for the regiment two medical officers would be needed.

(5) That every medical officer should train one year in three with the field ambulance in camp.

(6) That the annual training as to drills, riding, &c., should apply to all R.A.M.C. officers, and if they reside at a distance from drill facilities, that travelling expenses should be paid.

(7) I further suggest that a brevet rank should be created for officers who show keenness and capacity coupled with any special excellence.

At present there is always the dead-weight tendency that promotion comes by time more than by merit, and that if a man only sits tight he will eventually reach the top, however little he does.

If there was a brevet rank, even without pay, for special merit there would be an additional inducement to men to try to do the best that is in them.

DISCUSSION.

Colonel Harper said: On the whole I agree with the remarks of Major Oldfield, but am inclined to think him a little pessimistic. The officers under my command—I refer to those serving in regiments—while fairly keen and efficient, are subject to many of the disabilities mentioned by Major Oldfield. They are, however, able to make use of training schools, and, being members of our Mess, have opportunities of meeting their brother officers. There is one question which I would like to ask. When, after his volunteer service and subsequent field ambulance training, Major Oldfield resumed his service with a battalion, was his position much better than before? As to the suggestions made in the paper, it is proposed that all officers should commence by serving in a field ambulance. I see many difficulties in the way of making them join, but they might well be *attached* for a period of training. Of the two medical officers of a battalion, the one not with his regiment at any given training might be attached to a medical unit for the time being, provided there happened to be a vacancy; but there would be financial objections to this if no vacancy existed, and in this case the officer would have to serve at his own expense if he served at all. I fancy that very few field ambulance officers would volunteer for service in a regiment after enjoying the independence of service in a medical unit.

Captain Grant, R.A.M.C., said: I believe many of the difficulties to be inherited from an old and defunct system. If regimental medical officers find but little to do, this must be largely there own fault, as there

is a great deal to be done. No doubt, it is often owing to their having a lot of other work that certain officers elect to join a battalion instead of a field ambulance, as the tax on their time would be too great in the latter. As to the work to be done, there is camp sanitation, the drilling of the stretcher bearers, and supervision of the physical training of the men, &c. If the medical officers prepared schemes beforehand on these lines, and deliberately carried them out during the training, they would find their time fully and usefully occupied.

Colonel James said: One of the causes of the sad plight of the regimental medical officer of the Territorial Force is, I think, to be found in the fact that no comprehensive book on his duties exists. He has to find out what to do by being admonished for not doing it. Regimental surgeons have long been abolished—for very good reasons—and therefore the status of such officers is not realized. Nowadays the officer attached to a battalion—I refer to the Regulars—is always junior and does not suffer from the conditions so galling to a more senior officer in such a position. The training of regimental medical officers (T.F.) is obviously deficient, but improvement is hampered by want of money and, in the case of the officer himself, by want of time. He therefore tends to lose heart and gradually drops into the status of a "camp doctor." In the French Army, every M.O. puts in a certain time both with a medical unit and with a regiment. Such a system would be a great help if it proved to be possible. It seems to me that there is a want of a central school for territorial officers, but in the absence of any precise definition of the duties of the regimental medical officer, the instruction might, at present, be difficult to carry out. Such officers must be prepared to do duty anywhere, and this implies that they ought to be interchangeable in some way. The difficulty as to rank is a very real one. A lieutenant-colonel (medical) in a battalion is out of place and an anachronism.

Lieutenant-Colonel Salisbury-Sharpe said: One important point appears to have been missed in this discussion—the nature of the minimum of training allowed. The minimum laid down has been selected in order to make the voluntary system possible, but it results in this—that the man who only does the minimum is useless. This is a defect inherent in a voluntary system.

Major Irvine said: I think the "interchangeable" suggestion a good one. It has been found, on manœuvres, that medical officers of the regular forces are not sufficiently in touch with the duties of combatant troops in the field. It is now suggested to send out medical officers with regiments to learn, not so much the medical duties of a battalion, as the system on which combatant units work. If this is found necessary for regular officers it is certain that a territorial officer will require considerable training before he can be much use with a battalion.

Major Cummins said: The territorial regimental medical officer is handicapped by never seeing the result of his work, in so far as concerns

the success or failure of his sanitary arrangements. No camp, in peace time, can last long enough to afford evidence on this point. Both in South Africa and in the Spanish-American War the incidence of enteric fever began to rise about eight weeks after the troops had arrived in the area of mobilization, and this period may be taken as the normal incubation period of a "contact" epidemic. I regard the prevalence or otherwise of preventable disease as the best index of the efficiency of the regimental medical service. I agree with Major Oldfield and the last speaker in looking upon a system of interchange between medical and regimental units as the most promising suggestion for improving the territorial medical service.

Lieutenant-Colonel BURTCHAELL said: I had not intended to take part in the discussion this evening, but I feel obliged to express an opinion at variance with that of Major Cummins with regard to the sick-rate of a unit being taken, without actual knowledge of the qualifying conditions, as a test of the efficiency of its medical officer. The incidence of disease, more especially of typhoid fever, may, as has actually happened, depend on factors quite outside the control of this officer, who is still in the position of an adviser rather than an executive officer with regard to sanitation. It would be very unfair to judge a medical officer's efficiency merely from a perusal of a list of units which showed his unit to have the highest sick-rate.

Major WAGGET said: The real fact is that the vast majority of territorial officers do not know a tenth part of their work. It is not unwise that, in preparing ourselves for work, we should *concentrate* on one thing at a time. We in the field ambulances have a very jolly time at present, and I hope you will not spoil it by adding on regimental work as well. There is only a fortnight to learn in, and it would only spoil our chance of becoming efficient in one direction if we were to attempt to train on another line at the same time.

Major OLDFIELD, in reply, said: I gratefully accept the test suggested by Major Cummins, that of the health of the troops as the index of success in regimental sanitation. Their present training does not fit regimental medical officers to understand and provide against the special dangers to which troops are liable. It is for *training* that I appeal, not for a pleasant or merry time. I am indebted to Major Irvine for the hint that in the Regulars, medical officers are going to be sent out to learn more about battalion training. It is the going into camp which counts. I agree with Lieutenant-Colonel Salisbury-Sharpe that the man who does the minimum of training only is no good. Colonel James has greatly helped the discussion by pointing out that there is no book on the subject. It is to be hoped he will compile one at his leisure. As for the training of the band as stretcher bearers, a man who tries to catch a shadow is in much the same position as the medical officer who attempts to capture a bandsman for ambulance drill when his whole soul is yearning for

undisturbed practice on the trombone. The commanding officer, too, wishes to keep as many men as possible in the firing line and does his best to sweep all into his net. It is therefore very difficult to get hold of men for stretcher drill when in camp. Colonel Harper spoke of the facilities that exist for the training of regimental medical officers. But the existence of facilities is not sufficient. It is only the actual facts which count. How do the medical officers of to-day actually get trained? An A.D.M.S. can do a great deal, but in my experience he does not often do much. As for the officer commanding the regiment, I have always found him kind and gentle to the M.O. and willing to oblige him in everything except in carrying out his recommendations. After my service in a field ambulance my influence in the regiment was greater because I knew more. Lastly, I must hesitate to accept as final the opinion that no man would leave a field ambulance for a regiment. I believe that many a field ambulance officer would volunteer for service in a regiment if he knew what a fine field for useful and interesting work a battalion presents.

Clinical and other Notes.

AN OUTBREAK OF MALARIA IN "F" COMPANY, 2ND DEVON REGIMENT.

By Lieut.-Colonel T. B. BEACH and Captain H. H. LEESON.
Royal Army Medical Corps.

"F" Company, 2nd Devon Regiment, was sent from Alexandria to Cyprus on May 30, 1912, to assist in keeping order during some disturbances there. On arrival it was posted to Nicosia, where it remained one month, subsequently proceeding to Troodos (Hill Station) for three months. At the end of this time it was not considered necessary to keep the company in Cyprus any longer, and it was ordered back to Egypt. As the place of bivouac on the march down from Troodos to Limasol was reported to be malarious, prophylactic doses of quinine were given to all the men before leaving Troodos, 10 gr. on September 27 and 29. The march was about 35 miles, and they bivouacked for the night of October 1 at a place called Zeegoe. This place was apparently infested with mosquitoes, as most of the men complained that they were severely bitten that night. The next day they reached Limasol and embarked for Alexandria.

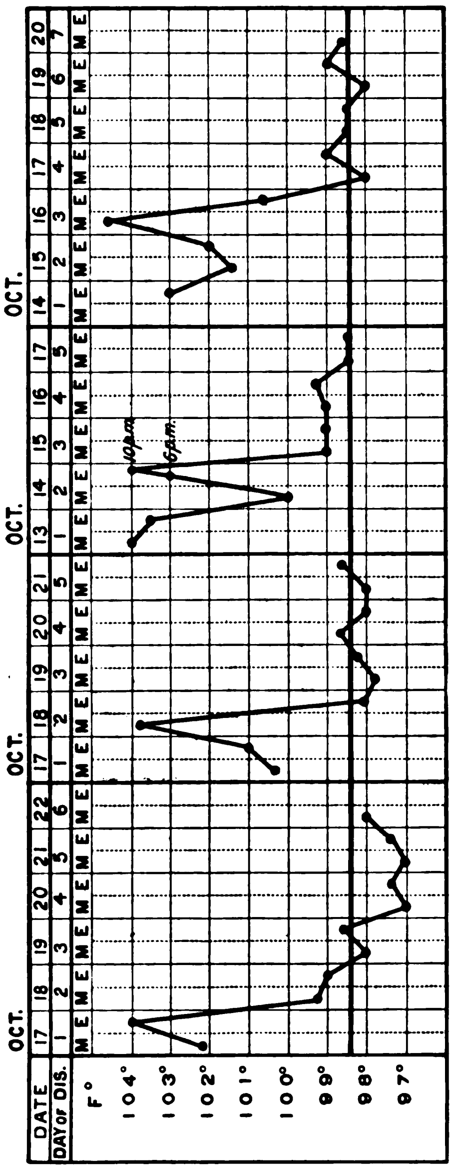
During their stay in Cyprus the health of the men was excellent: one man only, Private A., contracted malaria while the company was at Troodos.

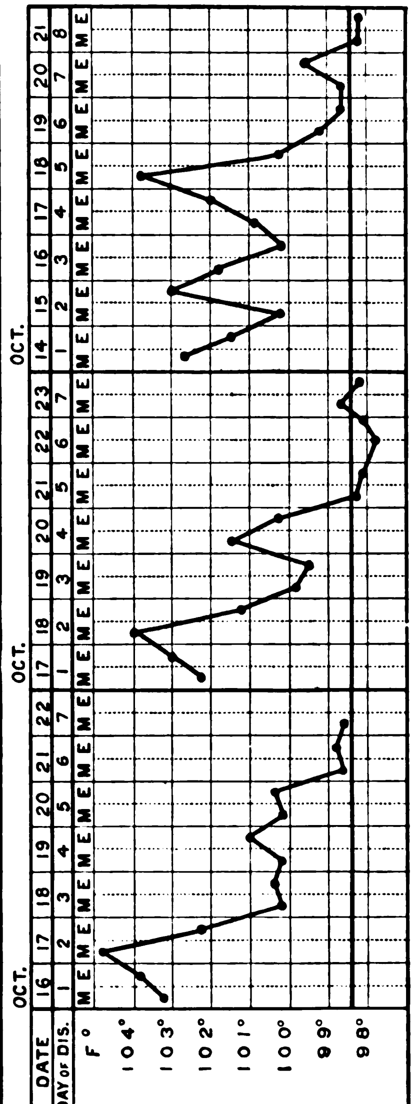
For eleven days after arrival in Alexandria the health of the company was good, but from October 13, cases of fever began to occur and a number of men were sent to hospital with symptoms suggestive of malaria.

The admissions were as follows:—

October 13, 1912	1
,, 14 ,, ...	7
,, 15 ,, ...	1
,, 16 ,, ...	1
,, 17 ,, ...	6
,, 29 ,, ...	1
Total	17

When all the circumstances of the case are taken into consideration, viz., the limitation of the cases to this company, their freedom from malaria in Troodos, their having been bitten at Zeegoe, and their immediate return to Egypt, there is no doubt that the disease was contracted on the evening and night of October 1, and this is interesting as showing very definitely the period of incubation.





The type of fever was very similar in all the cases, being that associated with the æstivo-autumnal type of fever. In some cases the fever lasted longer than in others, but in the latter it is possible that fever may have existed for a day or more before admission. The period of fever varied from two to five days. In all cases there was headache and malaise, in a few of them vomiting and gastric disturbance, and in one case inflammation of the liver with jaundice, the latter persisting for a long period. In none were there the typical cold, hot, and sweating stages with initial rigor, so commonly seen in cases of intermittent fever in India.

The fall of temperature was in most cases sudden, as in ague, but was not associated with the usual critical sweating. In a few of the cases the fall was more gradual. In no cases were there relapses.

Malarial parasites were found in several of the cases, viz., *Plasmodium malariæ* in three cases, malignant ring forms in two cases, suspicious forms in one case, and evidence of past malaria (malarial pigment, &c.) in one case, that of Private A., who alone had contracted malarial fever while at Troodos.

The character of the disease was early recognized, and many of the men were given quinine before the blood specimen was taken; this would account for the negative result of the blood examination in many of the cases. There is no reasonable doubt that they all had parasites in their blood, as the type of fever was practically identical in those cases where plasmodia were found and in those where microscopical examination failed to show them.

The accompanying charts from seven cases are sufficient to show the type of fever.

Treatment.—On admission every man had smears of blood taken which were sent for examination. He was then put to bed, and if the temperature was high, as it was in nearly all cases, symptoms were treated, diaphoretics and phenacetin being given to promote sweating, and the bowels were freely opened. As soon as the temperature fell and the symptoms slightly abated, the patient was given quinine, 20 gr., and this dose was continued daily for one week. At the end of the week the amount was diminished, 20 gr. in two 10 gr. doses being given every other day, and subsequently diminished to 10 gr. every other day. As soon as the patient was considered sufficiently recovered quinine was omitted for forty-eight hours, at the end of which time another smear of blood was taken. If this proved on examination to show no trace of malaria the man was allowed to go out of hospital. He, however, attended the inspection room in barracks daily for inspection and continuance of quinine in bi-weekly doses of 10 gr. for one month. None of the cases have since relapsed.

Prophylaxis.—As soon as the nature of the outbreak was known all the men who had been to Cyprus were paraded and a prophylactic dose of quinine, 10 gr., administered regularly twice weekly for a month.

DENGUE FEVER AMONG THE TROOPS IN CALCUTTA; ITS IDENTITY WITH SEVEN-DAY FEVER AND THREE-DAY FEVER.

By Colonel F. SMITH, D.S.O.
Royal Army Medical Corps.

Year after year the troops in Calcutta are attacked by a short fever which is productive of much inefficiency but no mortality. It has been returned as pyrexia of undetermined origin. This year it has been my good fortune to have to deal with the disease and to experience an attack in my own person. Last year (1911) very careful notes of the disorder were taken under the direction of my predecessor, Lieutenant-Colonel T. McCulloch, R.A.M.C. From reading these notes and seeing the temperature charts, I have no doubt that the fever of last year was the same as the fever of this year. I am confirmed in this view by officers who have seen the fever both years. The conclusion is arrived at that the fever of 1912 is the same fever as that of many previous years. This year the fever, I am sure, is dengue; if so the fever of previous years must have been dengue. But the same fever has previously been called seven-day fever and three-day fever. Therefore seven-day fever and three-day fever are in reality dengue.

The fever always comes in the hot weather. In 1910 there were 113 cases admitted to hospital from this small garrison, the diagnosis being pyrexia of undetermined origin. In 1911 124 cases were admitted. This year (1912) no less than 227 European soldiers have been admitted to hospital for the disorder, and 234 more have been treated in barracks, making altogether 461 cases up to date (October 27).

The disease has also run through a regiment composed of Indians from the Punjab side and north-west frontier. A regiment of Indians from the Madras side has been affected, but in a much lighter degree. Evidently then the disease has been more prevalent than usual this year among the troops. Calcutta has also been heavily attacked, so much so that startling headlines about the "New Disease" appeared in the lay press. Civil medical men discussed the question of diagnosis, and the majority decided that the disease really was dengue, while one or two held that it was the usual seven-day fever and not dengue. Some who admitted this year's epidemic to be dengue thought that it differed from the endemic seven-day fever. The military cases, exclusive of officers, women and children, were distributed over the months as follows, counting together both the admissions to hospital and the cases treated in barracks: April, 28; May, 37; June, 40; July, 62; August, 154; September, 105; October, 35 (to October 27 inclusive); total, 461.

The disease prevailed among officers, men and women alike.

The temperature curves vary a good deal, though the type is a saddle-back. Some of the men were admitted while in hospital for other diseases,

therefore their temperatures are fairly accurately recorded. Two indeed, convalescents from typhoid fever, were having their temperatures taken morning and evening up to the time when the fever began, so we are sure that we have accounted for all their days of fever.

The signs and symptoms are as laid down by Manson and Daniels. If there be any differences they are that the pains were rarely so bad as one would expect them to be from Manson's description, and that the secondary rash was not so universal.

But the pains are definite enough. In several cases, as in my own, they were almost the first of all the symptoms noted; they were thought to be due to sprains or to rheumatism, and were crippling in effect.

It may be objected that the shorter fevers are really sandfly fever. This is, of course, a possibility, inasmuch as we have sandflies. The short fevers and the longer fevers, however, are so much alike in symptoms and season of occurrence that it seems possible that they are one and the same disease. Sandfly fever is common in the north-west in certain areas (Attock, Nowshera, Peshawar, &c.). It is worthy of note that the regiment of Pathans who come from the sandfly fever part of India were much more heavily infected than the South Indian regiment. This fact suggests that the sandfly fever which the Pathans may be assumed to have gone through in their own country confers no immunity against Calcutta fever. One officer patient—a medical officer—stated that he had not long before had sandfly fever in the Punjab, and he thought the two diseases—sandfly fever and dengue, were distinct. Colonel Robinson and Major Blackham, on the other hand, in the October number of our Journal, include seven-day fever in their account of sandfly fever. The truth may be that the two diseases, sandfly fever and dengue, occur at the same time and place, and that it is not easy by clinical observation alone to distinguish three-day dengue from three-day sandfly fever.

The commonest biting insects during the period of greatest prevalence of the disease were Anophelines: *Anopheles rossi.* Culicines: *Culex impellens, C. fatigans, Stegomyia scutellaris, S. fasciata.* Other mosquitoes found were *Desvoidea obturbans, Culex concolor, Toxorrhynchites immisericus, Leucomyia gelida, Culex microannulatus, Mansonioides annulifera, Mucidus scaptaptagoides.*

A few sandflies were taken but these insects are not very numerous or troublesome in military areas in Calcutta. No papatasi were found, only *P. minutus* and *P. argentipes.*

Biting Chironomids which feed on man were also met with and were not uncommon during the period when the dengue was most prevalent. These insects can pass through an ordinary mosquito net, as indeed can some mosquitoes. *Stegomyia scutellaris* for instance.

The disease met with in Calcutta is extraordinarily local in prevalence. Stations within ten miles or so of Calcutta are said to be almost entirely free from it, though we have heard rumours of its appearance in more distant stations.

Fleet-Surgeon F. H. A. Clayton some time ago read an excellent paper on seven-day fever and dengue before the United Services Medical Society (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, February, 1910). He produced charts identical with ours. He mentions that when his ship lay off Calcutta at Christmas no dengue cases occurred, though the crew had been attacked at other ports. If the ship had been in the river off Calcutta in September or early in October this officer might have had a different story to tell. The disease ceased in October.

In a paper entitled "Further Notes on Fevers in Malta," and published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for July, 1909, Lieutenant-Colonel J. J. Gerrard gives some charts of fevers which seem to be similar to the Calcutta fever, as may be seen from the accompanying temperature charts, some of which are of cases which occurred among patients already in hospital for other diseases. The fevers vary in duration from two to eight days.

In a few cases the pyrexia only lasted for some twenty-four hours, in that it rose one day and fell to normal in the course of the following morning. These trivial attacks, however, can only be assumed to be the same disease as the more typical ones, because of their occurrence at the same time and place and at no other time.

Chart No. 1.

This chart is that of a patient, convalescent from typhoid fever, whose temperature was being recorded before and up to the time when he was attacked by dengue. The rash was very pronounced. After an interval of twenty-six days of apyrexia there was a short relapse with marked rash and a temperature of 103° F.

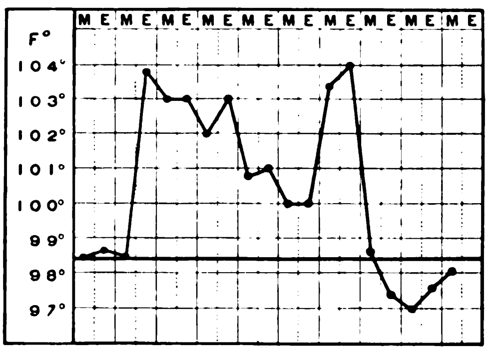


CHART 1.

This chart, which I think is typical, may be compared with No. 2, which is that of another patient convalescent from typhoid fever. The two men to whom these charts refer were the only occupants of the

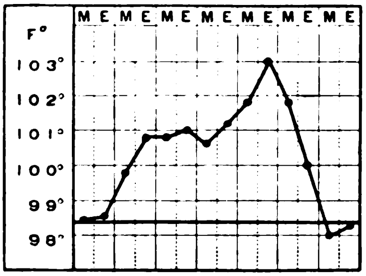


CHART 2.

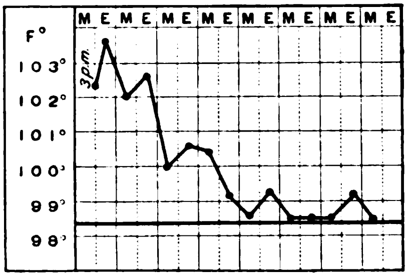


CHART 3.

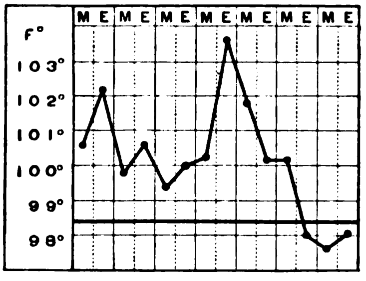


CHART 4.

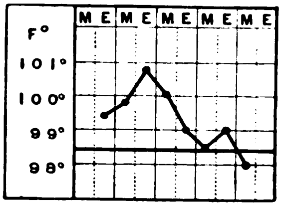


CHART 5.

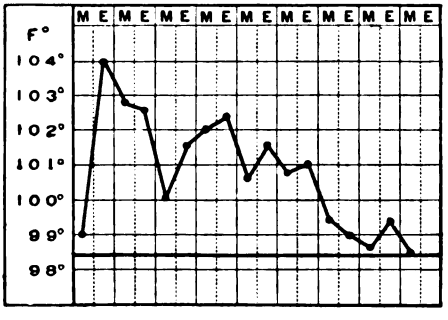


CHART 6.

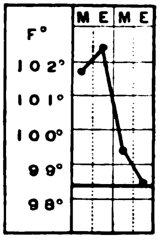


CHART 7.

typhoid ward. They were attacked within a short time of each other and were undoubtedly suffering from the same malady, yet the temperature curves are not much alike.

Chart No. 2.

This man had hyperæmia of the face and neck, but no mottling was noted, and no secondary rash.

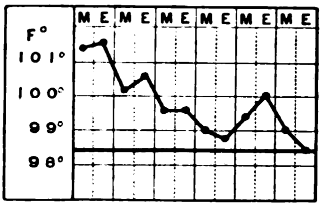


CHART 8.

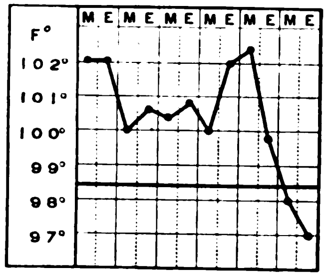


CHART 9.

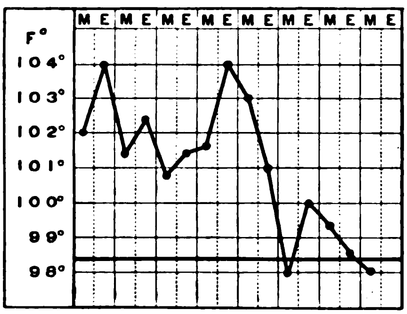


CHART 10.

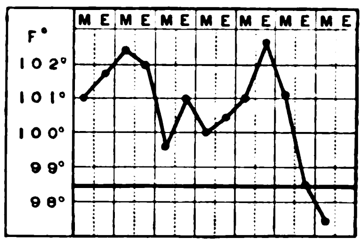


CHART 11.

Chart No. 3.

This is my own chart, and I am sure is a correct record. It is like neither No. 1 nor No. 2, but there is no doubt it was the same disease. The initial rash was in blotches of hyperæmia on the hands and face and the eruption, seen first on the hands, was mistaken for insect bites.

After eight days apyrexia there was a return of the blotchy rash for one day—the temperature, however, was only 99° F. Pains were severe and continued off and on for two months with gradually diminishing intensity.

Charts Nos. 4, 5, 6, 7 *and* 8.

These men were under treatment in the venereal ward, but their temperatures were not taken until they complained of sickness.

Charts Nos. 9, 10, 11 *and* 12.

These patients were admitted from barracks. The charts show the medial depression which has given rise to the term "saddle-back" as applied to temperature curves.

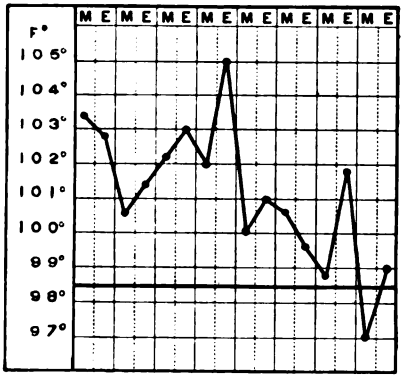


Chart 12.

I have to thank Assistant-Surgeon E. S. Feegrade, I.M.S.D., and Assistant-Surgeon J. A. da Costa, I.M.S.D., for much valuable help in the study of the epidemic.

THE STERILIZATION OF SKIN AND WOUNDS.

By Captain COLIN CLARKE.
Royal Army Medical Corps.

The use of tincture of iodine for the preparation of the skin previous to operations is now very general. The results obtained are excellent.

In the following article I have ventured to bring to the notice of my brother officers my experience of a solution of mercury perchloride in methylated spirit, strength 1 in 500, as a skin and wound sterilizer. Both these drugs are contained in the field surgical panniers, and in many respects the spirituous solution of mercury perchloride is superior to tincture of iodine in surgical work. The perchloride of mercury is present in the form of tabloids, and the methylated spirit is provided for the sterilizer lamps.

Anyone who has worked much with tincture of iodine recognizes that there are certain inconveniences attached to its use.

Drawbacks of Iodine Solution.—(1) When the iodine solution is applied to a large area of skin, e.g., the abdomen, a very irritating vapour is given off as the solution dries, and this causes considerable annoyance to the operator and his assistant.

(2) Iodine stains the skin, and this renders it unsuitable for the operator's hands. Two different antiseptics must thus be used during an operation, one for the skin of the patient and another for the operator's hands.

(3) Iodine solution causes considerable burning pain and local irritation when applied to the scrotum, penis, anus and vulva. This is a serious drawback when one has to operate upon hernias, varicoceles, hydroceles, &c.

(4) Iodine stains all clothing and towels it comes in contact with, and one would not like to carry a bottle of iodine solution in the uniform pocket, in case the bottle were to leak or get broken.

(5) When applied to a raw or inflamed surface iodine causes great pain which often lasts, in the case of inflamed tissues, for several minutes.

Advantages of Spirituous Perchloride Solution.—(1) A 1 in 500 solution of mercury perchloride in methylated spirit is quite as efficient as tincture of iodine when used as a skin sterilizer.

(2) No irritating vapour is given off as the solution dries on the skin.

(3) It can be used to sterilize both the operator's hands and the patient's skin.

(4) The perchloride of mercury solution can be freely applied to the scrotum, penis, anus and vulva without causing any local blistering or desquamation.

(5) Towels and clothing are not stained by this solution, and a bottle of it may be carried in a uniform pocket without fear.

(6) The perchloride solution is much less painful than tincture of iodine when applied to raw or inflamed surfaces.

(7) The spirituous perchloride solution is cheap, costing about 3½d. a pint in Malta (hospital price).

Practical Experience.—Since January, 1912, all the operation cases at Cottonera Hospital, Malta, have been prepared in the following simple way:—

(1) The skin is shaved if necessary.

(2) Ten minutes before the commencement of the operation the skin is freely swabbed over with spirituous perchloride solution (1 in 500).

(3) A second application of the solution is made immediately before the first incision, the ten minutes' interval mentioned above being occupied by anæsthetizing the patient. The spirit solution can be used with great freedom for both the operator's hands and the patient's skin.

A towel, or cotton wool pad, soaked with the spirit solution, should not, however, be left in contact with the patient's skin for long, as a superficial burn can be caused in this way.

The following is a list of operations performed after the patient's skin had been prepared in the way described above:—

List of Operations.

Minor operations for cysts, bursæ, hammer-toes, &c.	65
Excision of varicose veins and varicoceles	20
Hernia (radical cure)..	15
Appendicectomy (abdomen closed)..	15
Appendicectomy* (abdomen drained)	8
Excision of intra-articular cartilages, knee-joint	4
Fractured patella (wired)	2
Exploratory laparotomy	2
Total	131

Eight cases of suppuration, peritonitis, and appendix abscess marked with an asterisk (*) in the above list required drainage at the time of the operation and healed naturally by granulation.

All the other operation cases healed aseptically, by first intention, and no case of suppuration or stitch sinus occurred amongst them.

Cultural Experiments.—Strands of dry, unprepared catgut were thoroughly infected by soaking for eighteen hours in cultures of the following pyogenic organisms: (1) *Bacillus coli communis*, (2) *Staphylococcus aureus*, (3) *Staphylococcus albus*.

The infected catgut strands were then dipped for various periods in the spirituous perchloride solution. The strands were then washed in sterile water and cultivated.

It was found that two minutes' immersion in the spirituous perchloride solution rendered the infected strands of catgut sterile.

Wound Sterilization.—For cuts, abrasions, and wounds of all descriptions, the spirituous perchloride solution was found to be a most valuable antiseptic wound paint.

When applied the spirit solution causes coagulation of the blood and exudate on the surface of a wound, and the antiseptic scab thus formed prevents the subsequent entrance of any pyogenic organisms.

For the treatment of wounds the practice adopted in Malta is to keep in each medical inspection room a bottle of spirituous perchloride solution. The bottle is fitted with a perforated cork and a brush. The orderly in charge of the medical inspection room is instructed to paint all wounds and abrasions with this antiseptic paint at the earliest opportunity.

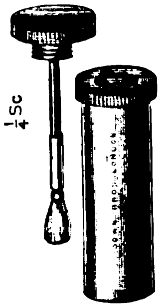
The results of this simple routine treatment for wounds have been most satisfactory, and a great number of septic wounds have thus been prevented.

Large raw surfaces have been painted with this solution, but no case has ever shown the slightest sign of mercurial absorption. The perchloride of mercury is precipitated and combines to form an insoluble albuminate on the surface of the wound.

Treatment of Bullet Wounds.—If an antiseptic solution is to be of any value for the treatment of bullet wounds in the field it is absolutely necessary that the antiseptic solution should be available when the first

field dressings are applied. An antiseptic solution kept in the field surgical panniers, at the dressing stations, will be of very little use, for most of the bullet wounds will be dressed on the battlefield itself or at the nearest aid-posts.

Regimental medical officers and stretcher-bearers who will have to dress a great number of bullet wounds, are not provided with any means for sterilizing the bullet wounds before applying the first field dressings.



The Pocket Wound Sterilizer.

Messrs. Down Bros., of London, have made for me a "Vulcanite Pocket Wound Sterilizer." The vulcanite bottle is provided with a screw-down lid, to the under surface of which is attached a small brush. When filled the bottle holds 2 oz. of spirituous perchloride solution, sufficient to paint forty or fifty ordinary bullet wounds. The bottle can be kept in the horizontal position, or upside down, for weeks, without any of the spirit solution escaping. The brush, being carried in the spirit solution, is always sterile and ready for use. When empty the bottle can be refilled from the nearest field surgical panniers, and can be easily carried in a uniform pocket, for the solution does not stain clothes.

To dress a bullet wound all that is necessary is to paint freely the entrance and exit wounds with the perchloride and methylated spirit solution, and then apply the first field dressing in the usual way.

Echoes from the Past.

THE "DEATH MARCH" THROUGH THE KHYBER PASS IN THE AFGHAN CAMPAIGN, 1878-79.[1]

By Surgeon-Major G. J. H. EVATT, M.D.
Medical Staff.

(*Continued from p.* 364.)

CHAPTER V.

Advance to Jalalabad.

The hospital remained at Dakka until March 25, 1879, when it was relieved by a field hospital of the 2nd Division, which division was then moving up the line of communications to allow the 1st Division to push on to Gandamak.

General Tytler and his brigade also moved forward at this time to Jalalabad, and he was most careful to give strong escorts to the hospital. The writer has in war time been left in imminent danger on occasions without any escort whatever, surrounded by helpless hospital servants and defenceless doolie bearers. No soldier is ever exposed to such risks in ordinary war experience.

Sir Sam. Browne was then at Jalalabad, where the head-quarters of the 1st Division were concentrated. A large hospital had formed there under Surgeon-Major Porter, Medical Staff, who had arrived out from Netley in March. On the writer joining this head-quarters hospital his independent existence merged in the larger hospital.

Advantage was taken of the stay at Jalalabad to visit the many interesting Buddhist remains which surround this historic old town, and we found in Mr. Simpson, the war artist of the *Illustrated London News*, a most enthusiastic cicerone. Sculptured faces of the Græco-Buddhist type were obtained in quantities, and shrines were unearthed which had evidently been covered up since the period of the Mohammedan invasion some 700 years before. Buddhist caves are also found on the banks of the Kabul river close by Jalalabad.

As far as Jalalabad itself was concerned, we had the good fortune to be taken round the walls by Major Bailey, the Paymaster of the Rifle Brigade, who had taken part in the old siege in 1841.

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[1] Reprinted from No. 82, vol. xix, *Journal of the United Service Institution of India*, 1890.

It was a most interesting and an almost unexampled occurrence that, forty years after an event like the old siege of this town, one should have had the opportunity of hearing an eye-witness describe what he had seen in the past. "From this point we saw Brydon approach." "There it was that Dennie fell." "I remember when the earthquake occurred, I was just here." "That is Piper's Hill," and so on. There were in the force also some old native officers of native cavalry who had been up the Khyber in the old war, and at Kabul. There was a Hindustani who had been a bugler in the old army, and had remained behind at Kabul and married in the place. Certain Gurkhas of the Charikar garrison of the old days had survived the massacre there, and had remained in Kabul; some of these visited the Gurkha regiments in the Bala Hissar in 1880.

On the night of April 2, 1879, while sitting in the mess tent after dinner, a horse was heard galloping into camp, and some one said, "Hallo, some one has come to grief," and as Surgeon Cornish had gone out that evening on reconnaissance duty with a cavalry force under Major Wood of the 10th Hussars, there was some chaff as to its being his horse. Immediately after a stampede of horses came through the camp, and in a few moments orders came for the ambulance detachments to fall in and move down to the river. Surgeon Ryan and the writer were with one of these parties, and we took a team of doolie bearers, &c., down to the river side. It was a dark night but the stars were out, and the Kabul river was dashing turbulently over its rocky and boulder-covered bed, the snowy foam standing out clear and distinct against the dark waters. The roar of the river, which seemed to be in flood from the melting snows further up, drowned every other sound. We could scarcely hear each other's voices as we traversed with difficulty the broken banks of the river, and made a search along its course for a considerable time. Except the sound of the rushing torrent all was still as the grave, and not a trace was evident of the catastrophe that had just occurred; and one officer and forty-six men had been simply wiped out by an accident which probably will not happen again for centuries. Owing to a gap in the column the leading men of a troop of the Hussars missed the ford, and seem to have gone over into the deep water, and had been swept away without giving any alarm whatever. Many of the bodies were carried miles down the river towards Dakka, amongst others that of Lieutenant Harford.

As daylight came on and the banks lower down were searched,

the bodies were found jammed amongst the boulders and under the rocky banks. The men were in full field marching order, khaki with putties, and warm underclothing. They had their swords on, and carried their carbines slung over their shoulders, and their pouches were full. A man so accoutred simply had no chance against the swollen river.

The bodies as they were found were brought to the mortuary tents of the field hospital, and they presented a most painful sight. Fine men in the full vigour of life, dressed and armed for the fight, were lying in every conceivable position of pain and contortion, and many seemed to have been kicked by the troop horses in the struggle, or dashed against the boulders and injured about the head and face.

They were buried together in one long grave in the Jalalabad temporary cemetery.

Surgeon Cornish, who was in charge of the column, escaped by wonderful luck, but the poor fellow was shot down by the Boers a year later on that fatal Majuba Hill, and died on the field. Had a choice been his, he would have rather perished with the hussars of his own regiment to which he was devotedly attached.

Sir Charles Gough's action with the Khugianis at Fatehabad in front of Gandamak, occurred almost simultaneously with the disaster to the hussars, and the dead body of Lieutenant Wiseman of the 17th Foot, who was killed in the Fatehabad fight, was also sent down to Jalalabad for burial. This officer, who was not of high stature, was cut down while attempting to capture an Afghan flag, and was desperately slashed about the face with the murderous Afghan knife, the wounds of which are certainly thorough in the fullest sense.

But the Fatehabad fight, apart from its perfect result in overawing the Khugianis, who after it gave no more trouble, will long remain memorable as being the place where Captain Wigram Battye, of the Guides, met his death. He was an officer of the most singular charm of manner and greatly beloved by every man in the column who had the pleasure of knowing him. Already wounded in the Ambela Campaign, he met his death by a bullet wound at Fatehabad, and leaves a name which cannot be forgotten for many a day. His death was a serious loss to his regiment.

Jalalabad was now getting hot and the dust storms were very trying, so that when definite orders for the advance of the division towards Gandamak were received, every one was glad who was nominated for the movement.

The writer marched up with the main portion of Surgeon-Major Porter's field hospital, and the march was again made memorable by the utter fatigue and trouble caused by the unwieldy field hospital camel trunks weighing down the underfed camels; for the march to Gandamak is a gradual rise the whole way. The time was spent on the march pulling and hauling at heavy camel loads, and helping the animals to rise. While at this work one day I saw the field hospital purveyor, a kind of commissariat gomashta, in whose nominal charge all the equipment was, passing onward reclining in a doolie, and not taking the least interest in his burdensome loads.

The whole purveyor system, by which a commissariat subordinate is placed in nominal charge of hospital equipment, although his men are too few to load it or care for it on the march, is a wretched compromise. These men like all who serve two masters really serve neither, and play off the medical against the commissariat department on a kind of battledore and shuttlecock principle, rendering themselves and their servants an element of indiscipline in any hospital.

After seeing the medical services of many European armies, I find that it is only in India this system now survives, and if the medical service demands power to do its own work and freedom of outside control, it ought to accept the responsibilities these claims entail, and be fully answerable for all equipment needed in its work. Half measures in this as in most things develop half men.

Marching on past Rozabad with its pleasant country houses, and also past the newly-formed post of Fort Battye, below on the left of the line of march lay the shady gardens of Nimla Bagh, after which the column reached the height of Gandamak, or Safed Sang, where the division halted.

CHAPTER VI.

Gandamak.

The air on those breezy heights in the early April days was cool and pleasant, and in front of the camp rose the pine clad slopes of the Safed Koh, whose peaks were still crested with snow. Along the lower slopes of these mountains lay a series of pleasant looking villages, and a track led through them to Jalalabad, far shadier and with more water-supply than the central road on the valley by which the division had to march. It was such a pleasant change from the heat, the sand, and the flies of Jalalabad.

At first the force encamped in comparatively low-lying ground of alluvial clay, but after a few days there it moved to a new camp site on the stony higher ground, and the doctors were busy for some time in organizing their new hospital camp. The sick began to increase as the weather got warmer, and many cases of typhoid occurred amongst the officers and men. The force lost here Captain Preston of the Rifle Brigade, Allfrey of the 17th Foot, and some other officers.

Continual shaves were in circulation as to an advance in light order on Kabul, and the medical department was continually being called upon to state what was the very minimum of equipment with which it could move on Kabul. The most hard man to deal with in all such questions was Colonel Macgregor, then Chief-of-the-Staff to Sir Sam. Browne. Apparently in the rudest health himself, and cast in the mould of a Titan as far as muscular strength was concerned, he did not realize that an army should have sick and wounded, and needed carriage or establishments. This of course is a wrong idea. The more civilization advances in times of peace, the more will the return to the comparative savagery of war and field Service affect that large number of men in the world whose systems keep in working order by a regular routine of food and order. The moment anything occurs to throw this routine out of gear, sickness results with many men whose equilibrium of fitness is easily disturbed.

But to try and ignore what cannot be ignored is vain work, and it is better to accept the facts as they stand and provide for them than to try to crush out what in the end never is crushed out. No army yet ever marched ten miles into an enemy's country, nor was left for a few hours without food, that the weakly men did not begin to break down, or those who managed to exist in cantonments with regular meals and light work did not begin to yield to the strain of field service.

Colonel Macgregor seemed to remain rooted in the idea that the medical department needed too much, and that Kabul could be rushed without losing more than a few men.

As regards the opinion of staff officers in general on medical work in the field, it should never be forgotten that, while a staff officer during his training for his duties, is sent to cavalry, artillery and infantry, to gather a general insight into their internal routine and methods of work, he is never sent to a hospital to see its working, nor does he ever see field hospitals at work in peace. He knows nothing therefore of the interior economy, of its fatigues, its

responsibilities, or its many weaknesses in trying to carry out its work. He may, therefore, find fault at times without knowing the causes of the faults discovered.

A medical officer said that during a campaign he was dropped on by a staff officer for being late in moving off his field hospital. He replied, "I have been hard at work for hours this morning trying to be in time. Had you known my troubles, you would certainly not have found fault."

When it is remembered that batteries and battalions are every day in peace practising their war routine, and that every man in the unit is as a rule able to help himself, while the medical service practically never sees its equipment or its personnel until war is declared, the difference in rapid working is easily explained. A field hospital can be made as mobile and as efficient as a field battery is mobile and efficient; when the hospital gets the same continued practice, the same good personnel, and the same opportunities of efficiency. Medical officers would like very much to ask any non-medical-staff officer to take over 100 helpless men, try and move them off in time, with the scratch teams of wholly undisciplined followers. The experience he would gain would do him much good, and he would learn the difficulties. It is also to be remembered that general command in the army never comes to medical men, and they are never in a position to enforce their demands for help.

As the idea of an armed advance on Kabul died out, the only excitement that occurred at Gandamak was the report that the Amir Yacoob Khan would probably come down to arrange the treaty himself, and in May he did arrive. A camp was pitched for him in a grove across the Safed Sang stream, and various parades were held for his amusement. Here for the first time in India Gatling guns were used, but they were not very successful, the machinery jamming at intervals.

The Gandamak treaty was at length formulated and signed, and many will remember seeing Mr. Jenkins, the Assistant Political Officer, starting for Simla to lay it before the Viceroy; the document itself enclosed in a tin case carried carbine fashion behind his back.

CHAPTER VII.

THE "DEATH MARCH."

As soon as the ratification of the treaty was complete, arrangements had to be begun for the return of the troops collected at Gandamak and on the communications to India, and the mass of sick at the field hospital had to be arranged for.

Cholera was already prevalent in the Peshawar Valley, and the question had to be discussed whether it would be wiser to push the troops down into the cholera haunted Peshawar, and Northern Punjab, or to remain at Safed Sang during the hot months, and return to India in the autumn, when cholera would probably have ceased.

The medical authorities at Simla decided that remaining at Safed Sang would not mean escape from cholera. There was at that time at Simla a very able sanitary observer, whose opinion on any such question was of great value, viz., Surgeon-Major Brydon, who was at that time statistical officer to the Surgeon-General with the Government of India. Anyone who reads his papers will see what a clear-sighted and philosophical observer he was.

The wave of cholera was evidently moving up the Khyber, and even if part of the army did remain on the high ground above Jalalabad, a very large proportion would have had to remain along the Jalalabad, Dakka, Peshawar line to hold the communications, and they would have suffered severely. The cholera did eventually move up the Kabul road, and at Kabul itself did much mischief. When the return to India began, it fell to the writer's lot to march from Gandamak towards Peshawar on June 6, 1879, with a large sick convoy, similar detachments of sick having moved off daily for some time previously. Thus began the fatal and exhausting "*death march*," in which Sir Sam. Browne's division retired from Gandamak, leaving its airy heights for the stifling Jalalabad plains, and onwards into the furnace-like gorges of the rock-surrounded Khyber route. The convoy consisted of fifty European and thirty native sick. There was a mass of several hundred doolie bearers undisciplined, practically unorganized, and without any staff to keep them in order. The labour of getting these masses of men into order, and preventing them shirking their duty was very great.

While other officers in the same column joined their battalions or batteries a few minutes before the hour fixed for the column to move off, and found their companies standing on parade, practi-

cally ready at once to move off, the medical officers had to rise two or three hours before reveille, to call their kahars, prevent their running away, give early refreshment to the sick, strike camp, and be in time to move off with the column. Work like this is most exhausting. Only by the greatest efforts was it possible to move off in time with the column, and many convoys were late, and delayed the troops in marching off, thereby throwing out all arrangements as to time or distance. This always will be the case in war so long as the sick are in the hands of undisciplined camp followers with no cadre of trained men to give them form and order.

Judging by subsequent experience in the 2nd Afghan and Soudan campaigns, there is no doubt whatever as to what a medical officer should have done on this fatal return march. He should have applied to the General Officer commanding the column for a permanent armed fatigue party or hospital guard of English soldiers, and have let them day by day assist in the toil of starting a large convoy of helpless sick, so that the General might feel that he and not the medical officer was really responsible for the safety and care of the sick of his force.

Fifty men so detailed, like the infantry escort of a battery of artillery, would in a few days have learned the routine of starting the convoy, and 4 or 5 per cent of native non-commissioned officers, sent for duty with the kahars, would in a few days have so wheeled these consummate shirkers into line, as to minimize at any rate the daily grind of collecting them, moving them off, keeping them together in the column, and finally pitching camp on marching in.

The absence of peace training, and the divided responsibility over the ambulance transport which enables every intelligent rascal to escape serving either master, is to blame for much of this, and it would be better to accept a very small but permanent cadre in peace, that could be completely disciplined and drilled by the medical department than to be flooded in war with crowds of undisciplined rabble with no element of cohesion in them, and no trained cadre which could be a model and a help in assimilating the remainder. Divided authority is and always will be fatal to efficiency in any branch of the Service, and the more intelligent the branch the greater the danger.

It is so much the habit in both the military and the medical sides of organization questions to try and differentiate between the medical and the military services, that it requires some courage to say that every individual in the medical branch of the army requires,

in addition to his technical professional training, the spirit, the ideas, the discipline, and the methods of the soldier; and the highest technical efficiency in the military surgeon may be handicapped beyond measure, if it is not combined with what are called the soldierly virtues. Elaborate scientific training may be so overbalanced by slackness of discipline, want of punctuality, absence of knowledge of army methods as to how best to apply the scientific knowledge, that there is hardly any knowledge the soldier possesses the soldier-surgeon does not need.

An incident occurred during the very early part of the first campaign of which the writer had the fullest personal knowledge.

While in camp at Ali Musjid field hospital a medical officer arrived with the convoy from Jumrood and dined at the hospital mess. Amongst other questions asked of him, some one inquired who commanded the convoy. He replied, "I don't know what his name was, but he was a very active fellow, worked awfully hard and kept the convoy well together! I think he belonged to the cavalry." No more was thought of the matter at the time, but next morning, while walking about the camp with the medical officer, he said to another officer, "By the way, there is the officer who commanded the convoy yesterday."

The commander was recognized as Mr. Burke, the well-known Murree photographer. There is no doubt whatever that Mr. Burke, being with the straggling convoy, saw that it was his duty to do his utmost with the party of the convoy near him, and at all hazards get it into camp.

This fact is quoted to emphasize the opinion that, in an army in the field, no officer and no man in the force can strictly and accurately define his own duties. He must be ready to put his hand to any work, and undertake any fair responsibility, feeling that he works for the common aim of the whole force, viz., victory in the field.

Any divorce, therefore, between the medical service and the fullest training and drill in field routine in peace for war, and any wandering away from military methods of work, would end in failure on field service and inefficient working in peace. The almost constant absence of training in drilled accuracy of work in peace injures medical efficiency exceedingly in war, and much of it arises from the absolute fear the medical officers often have of practising the routine and the methods and the applied drill of the soldier; and as a result they do not know the weak points of their field system until they are in the field, and it is too late to remedy defects.

Leaving Gandamak at the dawn of a hot June day, the return column reached Fort Battye, the first post on the Jalalabad road, in good form; it felt the heat more at Rozabad, which is one march from Jalalabad, and on the third day it marched into Jalalabad, the sick suffering greatly from the heat, the frightful dust, and the marching in the daylight for fear of the enemy. The want of water was also much felt by the troops. Foreseeing the want of water for the sick, the writer had drawn pukals at Gandamak for the field hospitals, and we had during all this return march a constant fight to keep them from the attacks of the duty soldiers in the column. The regimental arrangements with the troops for water were bad, and although it is treason to say so, it was because they depended too much on the company bheesties.

For Afghan warfare these men are of little use, whatever they may be in the plains of India, where water may be replenished every few hundred yards or so as a rule. In Afghanistan water is only found at long distances apart, and a few minutes after leaving camp the hand-bheestie's *mussuck* has run dry, and he can obtain no more water until he comes almost to the next camping ground; in the meantime the soldier must do without. For it is to be always borne in mind that the ordinary water-bottle used in India, made of a soda-water bottle covered with leather, is no use in Afghanistan. There the air is dry beyond conception, and the evaporation from the body excessive, and the quantity of water the bottle holds is so little as to be useless. All those who remember the large bottles carried by the Amir's soldiers must have learned a great lesson from them, viz., the absolute need of having really large and useful water-bottles with every man in the column, soldier or follower. What is wanting in Afghanistan is the company pukal on mules in charge of a soldier of the company who can prevent the water being wasted, or of an armed and disciplined follower for water duty. Such pukals take the place in Afghan warfare of the water cart used in European field service, and should be recognized accordingly, and by identifying them with the company, they should go with it on outpost or detached duty and be of great service.

Nothing to-day is so anomalous as to see a smart, well-turned-out mountain battery, whose duties compel them constantly to work on high ground where water is almost impossible to obtain, followed by a lame underfed tattoo with a magenta coloured tail and driven by a half-naked bheestie marching behind it. Most people would have thought that the water-supply would have been

carried on one of the best equipped and strongest mules of the team. In the Soudan the troops carried water in metal tanks fitting on the transport saddles, but they were not so cool and pleasant a water-carrying apparatus as the skin pukal. Before the army again crosses the frontier suitable provision for water-supply of the marching troops needs to be looked to.

About noon on the day of the arrival of the column at Jalalabad, a hot and dusty day, I was crossing over from the hospital camp towards the fort, when I met a gunner of the column coming towards me. He was faint and exhausted, and on his face was written in most unmistakable characters the fatal word "cholera." He was taken into hospital and arrangements made for his separate care until handed over to the local hospital authorities, but from that hour until the column separated at Peshawar the cholera haunted the march. The soldiers generally were in a depressed and exhausted state; the dust was very bad. Owing to an order from the General the troops did not march until daylight had broken and it was mid-June. Metalled roads there were none, water-supply was scanty beyond conception, and day by day the troops moved along the Jalalabad plain by Ali Boghan, Barikab, Basawal, and on to Dakka, and the mouth of the Khyber. The men seemed to age day by day from the heat, and the nights were so hot as to make sleep impossible.

While thus marching in the sultry valley, on the right rose clear and cool the pine-covered sides of the Safed Koh, the summits still covered with snow, and on the left ran the beautiful Kabul river miles away from the column, but still of great use to those lucky few who were able to run down to Dakka on rafts on its swollen waters. What an enormous boon to all future travellers it will be when the water route along the Kabul river from Peshawar to Jalalabad is made. It will deprive the journey of almost all its inconveniences.

"Sir," said one of the sick soldiers of the convoy who was travelling in a doolie, "I feel I am being roasted to death." But there was no help save to push on, and on the column pressed. Every one dreaded Dakka, which had acquired a bad name for health in the hot months of April and May. The cholera here was virulent to a degree. In one grave lie nineteen men of the 10th Hussars who perished in that most fatal spot, and numbers of men of other corps are also at rest here in the rude cemetery beside the Afghan fort. Surgeon-Major Kelsall of the medical staff lies in the same place. He died in his doolie on the road between Basawal and Dakka, and was hurriedly interred in the latter place.

Hurrying by Dakka the troops entered again the narrow defiles of the Khyber, a name deeply impressed on all English minds, but to-day not a shot was fired, nor did the ring of a single jezail echo on the mountains. Some baggage of the 9th Lancers was attacked, but nothing more. But day by day a far worse foe than the marauding hillmen dogged the troops, and the cholera clung to us, and there was no respite from the exhausting heat.

The worst day was at Kata Kushtia, a singularly narrow defile above Ali Musjid, where the cliffs on either side tower above the narrow causeway, and where the men had to encamp on ground which seemed to have been a constant camping ground for the troops who had preceded them. All day long the men were falling sick with cholera, and the writer, up to that date in rude health, began to feel exhausted from working all day in the sun, the increasing anxiety about the hospital, the weary grind of moving it off, the perpetual strain on the march of preventing the undisciplined baggage column from swarming in on the sick and suffocating them in their doolies, already as hot as ovens, and to crown all, the cholera. Whenever one tried to sleep one dreamed only of doolie bearers, and it was just like the worry of the march and quite unrefreshing.

The column encamped next day on the Sherghai heights, the heat on the stony ground being intense, and the want of water, despite all the efforts of the Ali Musjid permanent garrison, being very marked. At midnight the stones around were so hot as to be uncomfortable to the hand, and few if any slept even amongst the healthy men; what it was for the sick can be imagined. There was, however, one hope in front. The dear Indian plains would be in view in the morning, and the troubles as far as want of shade and water would disappear.

Next day the troops moved off at sunrise, as the lower part of the Khyber was said to be the most dangerous as regards marauders' attacks, and after a few miles' march one saw in the distance across the hills the ocean-like expanse of the plains. Travel where one may, in Persia, Afghanistan, Baluchistan or elsewhere, India is still the garden of Asia, and its people the most easy to get on with, and the most polite in the continent. Every one felt glad beyond measure to be as it were at home again, and bore the heat of Jumrood, a trying heat in June, with patience, but no one could look at the officers and men of the column without feeling that these were indeed those who had come out of great tribulation.

Compared to the men who a few days before had left the

Gandamak heights, a great change had taken place. Gaunt and haggard, marching with a listless air, their khaki clothing stiff with dried perspiration, their faces thick with a mud of dust and sweat, through which their red, blood-shot eyes looked forth, many suffering from that indefinite nervous affection called heat prostration, one could not help thinking with what a burden on her shoulders England maintains her weight of empire.

Every one had had enough of the Khyber, yet it is certain that if even then in that hour of sheer exhaustion and of a physical prostration which words can never fully paint, the order had come to face about and again enter the Pass *to go to Kabul,* all would have willingly turned round.

But the hour had not yet come, and of those gallant men that marched back into the then deadly Peshawar Valley, I must have myself seen fifty die of cholera, before in the September days of the same year we passed once more by the fort of Jumrood, the iron gates above Ali Musjid, and the graves of our comrades who perished in the campaign from which the troops were now returning.

Next day the troops were met at Harl Singh Burj by Surgeon-Major Porter, who with Colonel Sanford, R.E., had been the pioneers of the return march, and I received from him the most considerate P.M.O.'s congratulations that my hospital had come in in such good form, for sickness and exhaustion and overwork had played sad havoc with some of the other hospitals.

When after handing over the sick to the base hospital at Peshawar, one inquired where one's brother medical officers were, nine were reported to be lying sick, and only very few were fit for any duty, and it was difficult indeed for Surgeon-Major Porter to carry on the work. The doctors died and were invalided freely. Kelsall sleeps at Dakka; Wallace, whom all describe as a fine type of soldier-surgeon, lies at Landi Kotal; Gray died in Peshawar of cholera; Wright, who was with the Rifle Brigade and was a singularly sweet, nice fellow, died at Attock of exposure while getting his sick across the then unbridged river, and Dr. Gibbons, worn out by the campaign and the anxieties of the return march, survived one year and died in England, a broken man from the day he left the Khyber; the cheery, considerate Porter lived through the summer and the autumn, and on the second campaign went up with the Kuram column to Kabul and earned everywhere golden opinions. He, to the great loss of the army and the corps he belonged to, died in Kabul in the mid-winter of 1879-80, when his Chief, Sir Frederick Roberts, announced his death to the army in words

which will never be forgotten while the medical service exists, and of which it is sufficient to say that he earned them well.

The man most to be pitied during the campaign was the P.M.O., Deputy Surgeon-General Gibbons. He had neither secretary, nor orderly officer, nor proper clerks to assist him, and he ran his office with the rheumatic corporal before alluded to. The C.R.A. had his Adjutant, the C.R.E. an able officer as his Brigade-Major, but the P.M.O., who was responsible for the health of the division, the working of the hospitals, the organization of the convoys, and the statistical work of the troops, was single-handed. Dr. Gibbons over and over again complained that no notice whatever was sent him by the staff of movements for which medical arrangements had to be made, and in consequence medical officers were bustled off on expeditions with practically no warning, yet were blamed if all was not ready. Anyone can verify that by reading over the general orders issued in the later part of 1879, where Sir Frederick Haines draws special attention to this neglect, and directs more care to be taken in future.

Had Dr. Gibbons been the commanding officer of a medical regiment charged with the care of the sick of the division, he would then have had an Adjutant for discipline and secretary's work, and a Quarter-Master for camp and stores work, and he would have had orderly-room clerks, and Quarter-Master-Serjeants for detail duties; but he was more than this. His duties corresponded to that of a Colonel on the staff, charged with the administration of a strong department, and in daily communication with every station and corps on the line. No doubt whatever, what he should have done was to have taken, *per fas aut nefas*, a medical officer as his staff officer and secretary, and another young officer as his orderly officer, and then thrown on the authorities the duty of filling up the vacancies so caused. Then the work would have been easier and the wear and tear of the campaign minimized. However, he did none of those things, but attempted off his own bat to play a difficult and for him a fatal game. Had he died on the field the whole tradition of his office would have perished, as he had no one in his confidence or who knew what his plans were, and when we went to his office for orders, only a corporal was found there, to whom it was impossible to state one's wishes. The P.M.O. has to go out daily seeing battalions and hospitals, and if he has no one left in his office of commissioned rank it is very objectionable.

Finally, let it be repeated that the medical service, mobilized in a hurry, with little cohesion, with no defined method of work,

changed over at a day's notice from an old system to one entirely novel, with units not existing in peace for war but gathered together from the four winds of heaven, was not, and never can be under those conditions, an easy department to work on service. To-day things are better, at any rate people begin to know what they want; but the true model lies still before them, and that is the army one serves in and the units one sees daily at work around.

With such disciplined units, organized in peace for war, their work carefully thought out, their staff under the same control in peace as in war, with enough subordinates to do the wearying detail work, with orderlies trained and skilled in the care of the sick, and native attendants organized, drilled and trained as sepoys as well as hospital attendants, success may come; if with these there are sympathetic commanders who remember that the title "General Officer" means that he is equally interested in, and responsible for all under his command.

These ideals are not impossible, nor even difficult to realize. The faults existing are not wholly on the military, nor wholly on the medical side; both are to blame, and both have prejudices that must be either dissolved or rent in sunder. Either the medical service should throw up its claims to autonomy and accept a subordinate rôle with military commandants in every field hospital and a discipline and executive staff apart from the technical medical staff, or it should itself boldly claim all the titles, powers, and responsibilities which such commandants would receive. Men must know whom they are to obey, and discipline must be maintained, and the means of doing work must be given.

APPENDIX No. 1.

Return March of the Troops from Afghanistan to India through the Khyber Pass, June, 1879.

GENERAL ORDERS

BY HIS EXCELLENCY THE COMMANDER-IN-CHIEF, GENERAL SIR FREDERICK HAINES, G.C.B., &c.

Head-Quarters, Simla, October 14, 1879.

THE Commander-in-Chief has had before him a report from the Surgeon-General of British troops, of the medical arrangements and events connected with the return to India from Afghanistan, through the

Khyber Pass, in June last, of the 1st and 2nd Divisions of the Peshawar Valley Field Force.

(2) With cholera on the line of march, excessive heat, entire absence of shade, and a scarcity of water, the return march of the advanced columns must be considered one of the most trying operations of the war; and His Excellency is gratified to learn that the troops met the hardships, to which they were inevitably exposed, with cheerfulness, and that throughout an excellent and self-denying spirit animated all ranks.

(3) Sir Frederick Haines desires, however, to place more especially on record his appreciation of the valuable services rendered to the army on the occasion referred to by the Medical Staff of both Services, during the march itself and subsequently in the severe outbreak of cholera, to which the garrisons in the Khyber and at Peshawar were subjected.

(4) That the Medical Staff did not spare themselves in meeting the anxious and arduous responsibilities that developed upon them, is too sadly proved by the lamentable death within a few weeks of four of their number (Surgeon-Majors Kelsall, Wright, Gray, and Wallace), and the large amount of sickness amongst the remainder.

(5) While grateful to all for the zeal and devotion displayed in the discharge of most trying duties, the Commander-in-Chief is more specially so to Surgeon-Majors J. H. Porter and J. A. Hanbury, of the British Medical Service, for their able and efficient arrangements; and to Surgeon-Major C. J. McKenna, and Surgeons S. H. Browne and W. H. Cadge, of the Indian Medical Department, and Surgeon-Majors Melville Jones, G. J. H. Evatt, and H. Cornish, and Surgeons C. P. Turner and W. J. LeGrand, of the British Medical Service, for their praiseworthy exertions.

(6) Sir Frederick Haines is authorized to state that His Excellency the Viceroy and Governor-General in Council entertains the highest opinion of the efficient and meritorious services performed by the Medical Officers in the late campaign, and on the return march to India; and while deploring the loss of so many valuable officers, His Excellency has requested the Commander-in-Chief to communicate the thanks of the Government of India to the members of the two Services generally, and especially to those named in the preceding paragraph; and to the undermentioned officers who have also been brought to notice for their good services during the campaign:—

1st Division, Peshawar Valley Field Force.

Deputy Surgeon-General J. Gibbons, British Medical Service, Principal Medical Officer.

Surgeon-Major G. S. Davie, British Medical Service, in charge Divisional Field Hospital.

Surgeon-Major F. W. Moore, British Medical Service, in charge Base Hospital, Peshawar.

Surgeon-Major R. F. Hutchinson, Indian Medical Service.
,, S. C. Amesbury, ,, ,,
,, G. C. Chesnaye, ,, ,,
,, A. P. Holmes, ,, ,,
,, H. Cookson, ,, ,,
Surgeon H. Mallins, ,, ,,

2nd Division, Peshawar Valley Field Force.

Surgeon-Major A. M. Tippetts, British Medical Service, temporary Principal Medical Officer.

Surgeon-Major N. Ffolliott, British Medical Service, Base Hospital.

Kuram Force.

Deputy Surgeon-General F. F. Allen, C.B., Indian Medical Service, Principal Medical Officer.

Deputy Surgeon-General S. C. Townsend, Indian Medical Service.

Surgeon-Major J. Meane, British Medical Service, Senior Medical Officer.

Surgeon-Major Curtiss Martin, British Medical Service, in charge Base Hospital, Kohat, and subsequently of Field Hospital.

Surgeon-Major W. Nash, British Medical Service, Field Hospital, Ali Kheyl.

Surgeon-Major G. J. Gibson, British Medical Service, Field Hospital, Peiwar.

Kandahar Force.

Deputy Surgeon-General A. Smith, British Medical Service, Principal Medical Officer, under General Stewart.

Deputy Surgeon-General J. Hendley, British Medical Service, Principal Medical Officer, Quetta Force.

Surgeon-Major W. S. Whylock, British Medical Service, Field Hospital, Kandahar.

Surgeon-Major J. B. C. Read, British Medical Service, Field Hospital, Kandahar Force.

Surgeon-Major W. G. N. Manley, V.C., British Medical Service, Field Hospital, Quetta Field Force.

Surgeon-Major J. J. McCarthy, British Medical Service, Divisional Base Hospital, Quetta.

Surgeon M. Knox, British Medical Service, served with Field Divisional Hospital.

Warrant Medical Officers.

Apothecary E. Vyall,	Apothecary J. Barker,
,, J. Hogan,	,, H. I. Finnamore,
,, H. C. Hodgkins,	,, J. Forsyth,
,, C. Cordell,	,, P. Barrett.

In sub-medical charge of the several Field and Base Hospitals attached to all the columns.

(7) His Excellency in Council also desires his warmest acknowledgments to be conveyed to Surgeon-General J. H. Ker-Innes, C.B., for the very valuable aid he has rendered the Government. Sir Frederick Haines would add his own sincere thanks for the ready and able assistance he has at all times received from Surgeon-General Innes, who has added to a remarkable list of previous campaigns the distinction of having most successfully administered the Medical Department in the field throughout the late Afghan War.

The Surgeon-General prominently notes the valuable services rendered to him by his Secretary, Surgeon-Major J. A. Marston, M.D., Army Medical Department.

By order of His Excellency the Commander-in-Chief in India,

P. S. Lumsden, *Major-General,*
Adjutant-General in India.

Reviews.

The Sources and Modes of Infection. Henry V. Chaplin, M.D., Sc.D. New York; London: John Wiley and Sons, 1912. Pp. xi and 481.

It is not necessary to be a veteran in the war against disease to appreciate the remarkable change that has manifested itself in our attitude towards the modes of distribution and dissemination of pathogenic germs. Even those of us who are comparatively junior in the medical profession can recall the enormous importance that was until recently given to the survival of bacteria outside the human body, and the comparatively small regard that was paid to the actual infective person, except in cases of zymotic disease. All that has now changed—for the better, let us hope—and the human source of infection bids fair to take precedence of every other.

Dr. Chaplin is a warm advocate of the more modern view, and attacks shibboleths with a courage that is beyond praise. His summary of recent work on "Carriers" is excellent and thoroughly up to date. We would call particular attention to his remarks on the subject of epidemic cerebrospinal meningitis, which bring into prominence the great importance of carriers in the epidemiology of that disease. The author draws what we regard as a very sound distinction between "contact" and "fomites" infection in the spread of disease. "The term contact infection, as commonly used at the present time, does not necessarily imply the comparatively direct transference of quite fresh material from one to another." Indirect contact is thoroughly recognized, as by the intermediary of toys, books, &c., but such indirect sources of danger, to be

covered by the word "contact," must be the vehicles of very recent contamination. "Infection by fomites," on the other hand, is taken to mean "a transference of infective material on objects under such conditions that *considerable time* elapses, days at least, usually weeks, sometimes months."

Dr. Chaplin, while laying great stress on the former, gives only a very secondary place to the latter. Everything, he says, tends to bring into prominence the fact that bacteria rapidly die off under the conditions obtaining outside the human body. He looks on the spore-bearing bacilli as the only ones at all likely to be disseminated to any great extent by fomites. Indeed, so far does he go in this view that he regards the disinfection of rooms after diphtheria and scarlet fever cases as superfluous, an opinion which he supports by comparison of the "recurrences" in Baltimore, where disinfection is practised, and in Providence, where no such measure is in use. Great economies might be effected by the application of these facts in sanitary practice. "Many cities employ disinfectors, with horses and apparatus, while their laboratory languishes, their medical inspection is poor, and their diphtheria patients must secure antitoxin as best they may."

We are surprised that so logical a thinker should exclude from the category of "carriers" acute cases of typhoid fever, diagnosed as such. We see no difference between such cases and similar ones that have, through some error, escaped diagnosis, except that the former are under supervision. The only essential is that the infective material must be carried in the body of the patient, a factor which is obviously common to both. We notice that in quoting Bainbridge, Dr. Chaplin speaks of "complement-deviation" as the crucial test between closely allied bacteria. The "absorption test" of Castellani is that upon which most stress is laid in the articles quoted. This book is a thoroughly modern—in some respects a pioneer—work, and we warmly commend it to the attention of officers of the Corps.

S. L. C.

House-flies and how they Spread Disease. By C. G. Hewitt, 1912. Pp. xx and 122. Price 1s.

This book, one of the "Cambridge Manuals of Science and Literature," though primarily intended for the lay public, gives a very clear description of the house-fly, its structure, life-history and habits, in a form quite comprehensive enough for the medical man desiring to be in possession of the most recent views on the spread of disease by flies. The author makes an eloquent—not to say rhetorical—plea for the campaign against *Musca domestica*, in which all good sanitarians will join him. While entirely agreeing with the views expressed as to the mechanical transference of bacteria on the limbs and bodies of flies, as well as their ingestion and excretion through the alimentary tract of these insects, we would welcome further investigation, on the lines indicated by Faichnie, as to the persistence of *Bacillus typhosus* for considerable periods in the body cavities of flies fed on infected fæces. This question has been placed in a new light—at any rate for India—by a later observation of Harvey (Journal of the Royal Army Medical Corps, vol. xvi, p. 8, 1911), who demonstrated the occurrence, in the intestines of house-flies, of a harmless organism culturally similar to *B. typhosus*, but separable from the latter by serological tests. We

heartily recommend this little volume, not only to officers of the Royal Army Medical Corps, but also, in an especial degree, to combatant officers requiring a lucid and not too technical disquisition on the subject of flies as carriers of disease. S. L. C.

A System of Surgery. Edited by C. C. Choyce. London: Cassell and Co., Ltd., 1912. Vol. ii. Pp. xii and 1105. Price 21s. net.

The second volume of this work well maintains the reputation of the earlier volume, and deals with regional surgery.

The article on the breast, by Sampson Handley, gives an excellent account of the lymphatics; the operation for carcinoma and its contra-indications are fully described. The author emphasizes the necessity for a course of X-ray treatment after operation.

The tongue is very fully treated by Clayton Greene, a large amount of space naturally being devoted to malignant disease.

The article on the œsophagus, by H. M. Rigby, is one of the best in the book, and is most lucidly written.

That on the stomach and duodenum, by J. Sherren, is a very good account, but gives the impression of being rather condensed, although it obviously includes a good deal of the author's personal experience. In the article on the appendix and peritoneum, there is a very clear account of the treatment of these regions. The author emphasizes the need for operation in every case of appendicitis when it is diagnosed, and also advocates the removal of the appendix, when possible, in cases of abscess.

Hernia is very fully described by Lawrie McGavin, and the article is worth a careful study by medical officers. The author lays stress on a good convalescent period after operation. There is a very good account of the author's modification of Bartlett's filigree method of radical cure.

The advantages of spinal anæsthesia for hernia operations are well pointed out.

In the article on the kidney, a few more details as to operative treatment and after treatment would have been valuable, and it is a pity that the article on the liver makes no mention of the treatment of hepatitis by ipecacuanha, as recommended by Rogers, which is of great value in the after treatment of liver abscess.

Each section has a very full bibliography.

The book is to be recommended to those who are anxious to keep up with modern teaching in surgery.

A Manual of Surgical Treatment. By Sir Watson Cheyne, Bart., and F. T. Burghard. Revised, with the assistance of T. P. Legg and Arthur Edmunds (in 5 vols.). Vol. iii. Published by Longmans, Green and Co. Price 21s.

This volume deals with the surgical affections of the joints, spine, head and face. The subjects are freely dealt with, a large amount of space being naturally given to tubercular disease. A good description of Gauvain's method of treating spinal caries is given, but no mention is made of Bradford's frame.

The chapters on injuries and diseases of the head are much fuller than in the previous edition, and clear accounts of the various decompression operations are given. It would have been interesting to read

the authors' views on the value of blood-pressure readings during convalescence from concussion as an indication of recovery and ability to work.

The authors clearly show how, after treating the original seat of disease, the operation for exposing the mastoid antrum and middle ear may be extended so as to reach any of the complications.

The book is to be strongly recommended, particularly for the after treatment, which is given more clearly than in most surgical works. The illustrations are good and clear.

W. F. E.

THE NEW PHYSIOLOGY IN SURGICAL AND GENERAL PRACTICE. By A. R. Short. Second Edition. Bristol: John Wright and Sons, Ltd., 1912. Pp. xi and 244. Price 5s. net.

The second edition of this excellent work is of as high a standard as the previous one. There is a new chapter on the growth of bone, which embraces Professor McEween's work on the subject, and there is other new matter. The book presents the advances in physiology which are of clinical importance with great clearness, and is to be strongly recommended to any medical officer who wishes to make use of modern physiological advances in his ordinary work.

MASSAGE AND THE ORIGINAL SWEDISH MOVEMENTS: THEIR APPLICATION TO VARIOUS DISEASES OF THE BODY. By K. W. Ostrom. Seventh Edition. Published by H. K. Lewis and Co., London, 1912. Pp. xiv and 194. Price 3s. 6d.

This book gives a good description of the various movements in massage, but when the author wanders into the treatment of disease we find extraordinary claims, such as massage of the liver being a specific for the cure of piles. One agrees with the author's conclusions at the end of the book, that manual treatment in cases of disease should be under control of a qualified medical man, but judging from the number of diseases he claims to have cured by massage, one would hardly have thought they represented his views.

GUIDE TO PROMOTION FOR OFFICERS IN SUBJECT (*A*) (*i*) (REGIMENTAL DUTIES). By Major R. F. Legge. Fourth Edition, revised to date. Aldershot: Gale and Polden. Pp. xx and 155. Price 4s. net.

This book should prove very useful to officers of the Corps doing company work, and also to the lieutenants on probation when going through their course at the depot. The chapter on company books, messing, &c., is particularly good, and gives all the necessary information in a concise form. There are several printer's errors and slips in the text, but these are not of much importance. The system of putting a set of questions at the end of each chapter is excellent, though in one or two instances the questions are not answered in the text.

K. H. R.

VADE MECUM FOR OFFICERS AND CIVILIANS PROCEEDING TO INDIA. By Lieutenant J. E. Power. London: Forster Groom and Co., Ltd., 1912. Pp. 196. Price 1s. 6d. net.

This little brochure is a well-intentioned attempt on the part of its author to assist his fellow soldiers "to know the ropes"; he will probably acquiesce heartily in the expression. The assistance of an officer in the

Royal Artillery has been called in for advice on languages and sport, and it is a pity that Mr. Power did not add a chapter, contributed by some friend in the Medical Services, on health. In regard to sport, the only point on which this writer feels inclined to take exception is the remarks on what may be called bumble-puppy racing. Professional racing in India has ruined more sportsmen than it ever made horsemen. Bumble-puppy racing by men owning "a beast of some sort, and entering it in some race just for the sport of the thing," made many men horsemen, and ruined none in the old days. The deserted race-courses of some of our smaller Indian stations are the sign of its disappearance. One grave defect the book possesses, and that is the mentioning by name of certain firms—a special firm apparently for each article. Such a course lays a writer open to comment, and in any case, as the Toreador used to say, "There are others." C. H. M.

Die Schussverletzungen des Schädels im Kriege (Wounds of the Head in War). Veröffentlichungen a. d. Gebiete des Militär-Sanitätswesens. Heft 53. By Otto Holbeck, Senior Surgeon to H.M. The Empress Maria Feodorowna's Flying Column. $9\frac{3}{4} \times 6\frac{3}{4}$ in. Pp. 479. 13 diagrams, 59 charts, and 13 radiographs. Berlin: Hirschwald, 1912.

Holbeck has collected the records of 443 cases of bullet wounds of the skull which were treated in five different hospitals during the Russo-Japanese War. These records he has classified in various groups according to the nature of the wound, the symptoms produced, and the treatment adopted. Some of the statistics are interesting; as, for instance, of 11,843 wounded treated in the five hospitals, 4·9 per cent were suffering from wounds of the skull. Holbeck has made a most elaborate analysis of the records, but the total number of cases in each group is so small that his deductions must be subject to a large coefficient of error. The work is certainly of interest to any military surgeon who happens to have a large amount of leisure for study.

C. E. P.

Rag-Time. By Lieutenant-Colonel J. D. F. Donegan, R.A.M.C. 1s. net. London: Lynwood and Co., Ltd.

These verses are described on the cover as "A Collection of Military Poems suitable for Recitation." Furthermore, several pages of the Introduction are taken up by "Hints to Military Reciters." It is not, therefore, the fault of the author if the aspirant to sing-song fame is unable to do justice to his lines.

Colonel Donegan explains that he has tried to keep off the beaten track, and has alluded to the ordinary everyday episodes of military life in preference to the more glorious ones. Here are some examples:—

The Section D Man.

I'm out of the blooming army, serving in section D,
Now I'm a bus conductor, that is my job you see;
Armed with a bag of coppers, tickets all day I punch,
Working from dawn to midnight, never a sit-down lunch.

* * * * *

For it's a dog's existence, facing a wintry breeze,
Charging for kids as adults, unless they sit on knees,
Helping the fat old women off of the 'bus and on:
Oh, for the canteen sing-songs! oh, for the days since gone!

A Canteen Discussion.

They were talking in the wet canteen, where soldiers quench their thirst,
All sitting round at tables—the drinks were ordered first.
Then Private Michael Smith held forth; he had a lot to say
On the relative connection of proficiency and pay.
Himself a third-class shot—the cause was evident and clear,
From his workmanlike appearance when he faced a mug of beer.
The bullets from his rifle went on most erratic trips,
But arm him with a tankard, and he'd never miss his lips.

Aerial Scouting.

The party is fallen in, sir. I'd thought you'd inspect at flight.
The petrol tanks are full, sir, and the compasses seem all right.
At present we're in close order (just seventeen miles apart),
Six thousand foot elevation; we'll open out when we start.

Current Literature.

A Note on Elements resembling Spirochætes found in Blood Preparations from Man and Animal.—Major T. D. E. Holmes, Imperial Bacteriologist to the Government of India (*Indian Civil Veterinary Memoirs*, No. 3, 273). On examining blood films from animals suffering from diseases in which extensive blood alterations occur, forms like spirochætes are frequently found in the red corpuscles and also free in the plasma. The intra-corpuscular figure may resemble a loop of ribbon or string, or may assume the form of a circle 1 to 2 mm. in diameter. At times the rim of the circle is broken and the red corpuscle is crescent shaped. Occasionally deeply stained spindle-shaped bodies are found within the red cell. Many of the forms occupy a position partly in and partly outside the corpuscle. The extra-corpuscular bodies resemble a loop of ribbon or string folded irregularly on itself, sometimes as figures of eight, sometimes as spirals. The body is tapered at its ends and may be spindle-shaped. Many appear like two spirochætes lying closely together and joined at the ends.

A plate is given showing these figures as they appeared in blood smears of two malarial patients; some bear a striking likeness to spirochætes. Similar forms are also depicted which were found in the blood of a guinea-pig which had been inoculated with these malarial bloods.

The author refers to the observations of the Sergents published in the *Annales de l'Institut Pasteur*, 1905, concerning similar elements which they had discovered in the blood of ague patients and of anæmic animals. Brumpt noted appearances not unlike the foregoing in the same year. Laveran (*Soc. de Pathologie Exotique*, April 8, 1905) was acquainted with these objects, but considered that they were artefacts, an opinion which Nicholle and Comte also shared. Holmes is convinced that the figures are produced by modifications in the red blood corpuscles in certain diseases, such as malaria, trypanosomiasis, and piroplasmosis. On two occasions he observed ribbon-like bodies floating in the plasma while examining blood in the fresh state.

C. B.

Cancer in Rats and Cockroaches.—It has long been known that the irritation caused by certain parasites may set up malignant disease; for instance, cancer sometimes follows bilharzial infection of the bladder. The other trematodes, *Opistorchis felineus* and *Distoma japonicum*, have been the assigned cause of malignant tumours in a few instances. Cancer of the liver in cows has been associated with the presence of flukes. Borrel has been an exponent of such a hypothesis for several years; he thinks that the demodex, nematodes, and cysticerci are the transmitters of an unknown virus which excites malignant tumours.

In the year 1907, J. Fibiger, Director of the Pathological Institute of Copenhagen, found papillomatous tumours filling the stomachs of three rats. On microscopical examination ova of a nematode worm were discovered beneath the epithelium which had undergone proliferation and inward growth, though no definite carcinomatous infiltration was seen. Inoculation and feeding experiments on other rats were negative. Since that date he has undertaken laborious investigations on the subject, and has published his results in the *Berliner klinische Wochenschrift* for February 17 last: 1,144 wild and tame rats which he examined were free from nematodes and disease of the stomach; but of 61 wild rats which had been trapped in a locality where cockroaches, *Periplaneta americana*, were numerous, 40 harboured nematodes in their stomachs, and in 18 of these there were morbid changes in the stomach or œsophagus, in 9 malignant proliferation having set in; 57 laboratory-bred rats were fed with cockroaches caught in that place, 54 became infested with nematodes, of which 29 showed pre-cancerous alteration, and 7 malignant disease in the stomach. Hence he concluded that the malignant tumours were dependent on the presence of nematodes, and that the cockroach was the intermediate host of the worm.

The initial stages of the disease consist in hyperplasia of the squamous epithelium of the stomach ending in the production of large papillomatous growths; carcinomatous degeneration follows with typical epithelial nests infiltrating the wall of the viscus. Metastases were noted twice, neither nematodes nor their ova were found in them.

In the year 1878, Galeb described a nematode infesting the stomach of rats which he had fed with cockroaches (*P. orientalis*). Fibiger, however, thinks his is a new species, and names it Spiroptera sp. n. The adult worm lives in the squamous epithelium of the œsophageal and gastric mucous membrane of the rat, in the fæces of which the ova are distributed. He infected 26 of 27 cockroaches by feeding them with the ova, or the ova-containing excrement of rats. After ingestion the embryos are set free and migrate to the muscle of the pro-thorax and of the extremities of the cockroach, where they form trichina-like bodies. In 3 out of 12 rats which partook of these infected beetles, nematodes were found, and in one of these malignant proliferation was present; 101 cockroaches which were obtained from another locality were free from parasites; 43 laboratory-bred rats which were fed on these remained healthy.

C. B.

Rocky Mountain Spotted Fever.—W. B. Rucker (Reprint from *Public Health Reports*, No. 96, 1912, U.S.A. Public Health Service) gives a full account of Rocky Mountain fever, and appends a bibliography

of seventy-seven references. This fever is an acute endemic disease which occurs chiefly during the summer months in the States of Alaska, California, Colorado, Idaho, Montano, Nevada, Oregon, Utah, Washington, and Wyoming. It is characterized by a continuous moderately high temperature, severe joint and muscular pains, and a profuse petechial or purpuric rash which appears first on the ankles, wrists and forehead, but rapidly spreads to all parts of the body. The incubation period is from three to ten days, usually seven. The onset is marked by chilliness, nausea, and malaise. Pains are complained of in the muscles, bones, and joints, especially at the back of the head and in the loins. The face is flushed and the features are swollen; photophobia, epistaxis, and constipation are frequent; the conjunctivæ are congested, and are tinted with yellow; the tongue is covered in the centre with a heavy white fur, and its tip and edges are bright red. The temperature rapidly rises and continues high with only slight morning remissions till the eighth to the twelfth day, when it falls by lysis in favourable cases. The pulse is very rapid and thready; leucocytosis with mononuclear increase and diminution in hæmoglobin and erythrocytes is marked. Usually, on the third day, a macular rash appears on the wrists and ankles, and spreads consecutively to the arms, legs, forehead, back, chest, and abdomen. It becomes papular, petechial, or may result in large ecchymotic patches, hence the malady used to be named "black measles" or the "blue disease." The eruption fades with the fall of the pyrexia; desquamation comes on late in the convalescence. Gangrene of the ears, fauces, fingers, toes, or pudenda may follow. Jaundice and albuminuria are noted in half the cases; the spleen and liver are enlarged. The mortality varies from 4 per cent in Idaho, to 75 per cent in Montana. On post-mortem examination the spleen and liver are enlarged, the former to three or four times its normal size; hæmorrhages are seen beneath the pericardium, in the submucous coat of the intestines, and beneath the capsules of the kidneys. The lymphatic glands may be swollen.

When 0·5 to 5 c.c. of infected blood, serum, or washed corpuscles are inoculated beneath the skin of guinea-pigs, a rise of temperature takes place in two to five days, reaching its highest point on the fifth to seventh day, when it may be 107° F.; the scrotum and testes become red and œdematous; subcutaneous hæmorrhages occur; the soles of the feet and the ears are congested; emaciation is rapid, and the animal dies on the seventh to the eleventh day. If it recovers, the ears become dry and drop off, and desquamation of the soles of the feet is noted.

In monkeys the disease produces a cyanosis of the face and ears; an erythematous or petechial eruption appears on the back and limbs; the scrotum and penis are enlarged and hæmorrhagic.

The virus is less pathogenic to rabbits; a mild pyrexial attack appears on the fourth day or thereabouts. The scrotum becomes congested.

The wood tick, *Dermacentor andersoni*, is the transmitting agent. McCalla removed a tick from a man suffering from the disease, and infected a man and a woman by its bite. King and Ricketts conveyed the infection from guinea-pig to guinea-pig by means of ticks.

The virus cannot pass through a porcelain filter; it is destroyed in thirty minutes by a temperature of 50° C., but not till sixteen days at 0° C.

During the summer of 1912, McClintic discovered an infected tick

on the body of a Rocky Mountain goat (*Oreamnos montanus*). Goats and spotted fever abound on the western side of the valley, but on the eastern slopes, where there are no goats, there is no fever. It is also stated that in valleys where formerly many Angora goats were pastured there was much fever, but since their removal the disease has disappeared.

Ricketts immunized animals with the virus, and their serum exercised some preventive and curative action; therapeutically it had little effect on the human infection.

C. B.

Leprosy Bacilli in the Blood.—Marcus Rabinowitsch (*Berl. klin. Woch.*, February 10, 1913, p. 252) investigated the presence of tubercle bacilli in the blood of sufferers from tuberculosis, and published his results in 1906. In a few cases he succeeded in growing the tubercle bacillus directly from the blood, but more often he detected its presence by inoculating rabbits and guinea-pigs with the patient's blood. His observations have been confirmed by many experimenters, who have been aided by the use of the antiformin method. It is now known that tubercle bacilli circulate in the blood-stream of most tubercular people. These results led the author to a similar study of leprosy. Blood was withdrawn from the veins of the arms of lepers in a 10 c.c. syringe, mixed with an equal bulk of a 1 per cent sodium citrate and 1 per 1,000 sapotoxin solution, and after vigorous shaking was put in the centrifuge for fifteen minutes. The precipitate was washed with distilled water and again submitted to the centrifuge. The precipitate in each tube was then treated with 5 c.c. of a 10 per cent antiformin solution, and was placed in the 37° C. chamber for one hour, and then centrifuged for twenty minutes. The resulting precipitate was washed with water, and again thrown down by means of the centrifuge. The final precipitate was stained with carbol fuchsin in the usual manner, decolorized in 3 per cent hydrochloric acid alcohol, and counterstained with methylene blue.

Leprosy bacilli were discovered in the blood of six out of eight lepers, and in the heart blood of a fœtus whose mother was one of the six. Hence there is hereditary transmission of the leprosy bacillus from mother to offspring by means of the blood-stream.

C. B.

Detection of Ova in the Fæces.—Yaoita recommended the use of antiformin for the detection of ova in the fæcal dejecta. Wolff (*Berl. klin. Woch.*, February 17, 1913, p. 301) writes well of the method on account of its simplicity. Five fragments of fæcal matter, each about the size of a pea, are put into a test tube which contains equal parts of ether and a 25 per cent watery solution of antiformin. Pure antiformin, which should give 4 to 6 per cent free chlorine, destroys the ova. After solution of most of the excremental matter has been effected, the fluid is filtered through a hair sieve to remove the coarser particles, and the filtrate is centrifuged for one minute.

In 500 cases ova were discovered by this method 132 times, where the usual microscopical examination failed to reveal them.

The best results are obtained by culture in the search for ankylostoma ova. The dejecta are mixed with animal charcoal and are incubated at 25° C. for four or five days. The dish is then filled with water, into which the larvæ wriggle and can be readily seen. Wolff discovered these ova five

times by microscope, eight times by Yaoita's method, and sixteen times by culture in the 500 cases investigated.

C. B.

Report on Blackwater Fever in Southern Nigeria, 1899-1911.—By W. M. Graham, Director, Medical Research Institute, Lagos, 1912. The total European population of Southern Nigeria has risen from 1,054 in the year 1907 to 1,727 in 1911. The annual admission-rate for blackwater fever has fallen from 48 per 1,000 in 1907, to 14 per 1,000 in 1911; and the death-rate for the same cause from 7·5 per 1,000 to 5 per 1,000. During the same period the incidence of malaria has ranged from 517 to 763 per 1,000, with a death-rate of from 4 to 6 per 1,000.

The seasonal prevalence of 240 cases of blackwater fever is given. September is the lowest month with thirteen admissions, and August the highest with thirty. The incidence appears to be favoured during the dry months; and the months of maximum incidence become later in the year proceeding eastward: Western Province, July to August; Eastern Province, October to November. When blackwater fever appears in a station it usually recurs the next two years, after which it disappears for several years. The consecutive occurrence of cases in one place, e.g., a particular factory or among European associates, is well marked in all the available official returns. The onset of the fever comes on most frequently in the seventh and eighth months of colonial residence. A case is quoted of the disease arising four months after landing in England; but of sixty-seven newcomers to Southern Nigeria none was seized before the seventh month of residence. Twenty-nine instances are mentioned in which there was a recurrence of blackwater fever from two months to nine years after the first attack. The case mortality among the Europeans was 22 per cent in the period 1907-11. Only six cases were reported among the natives, three of which ended fatally. The author thinks that blackwater fever is not of malarial origin, since malarial parasites cannot always be found in the blood, and, when present, their numbers bear no proportion to the severity of the attack; moreover, he has rarely observed them during the first day of the illness, but has discovered them in about one-third of his cases on the second or third day, when the severity of the attack was diminishing. When quinine has not been given, malarial parasites may persist in the blood of blackwater fever convalescents for three weeks or more without influencing the progress towards recovery. Salts of quinine exercise no specific effect on the disease; on the contrary, their administration increases the severity of the attack. The monthly and annual incidence of the two ailments differ, that of malaria being greater in the wet months, and that of blackwater fever in the dry months. The West African coast towns are hot-beds of malaria, 100 per cent of the children are infected, yet blackwater fever does not occur.

Though the author states that in all the cases of blackwater fever which he had seen, the onset of the hæmoglobinuria had been preceded by a dose of quinine, yet no instance has been noted among the 200 to 300 prisoners of Lagos Gaol, who take 10 grains of quinine once a week. In the West African colonies almost every European has suffered from ague, and has received large doses of quinine. No prognosis of the issue of blackwater fever can be based on the number and severity of previous attacks of malaria. He inclines to a belief in the opinion which

is current in the colonies, that blackwater fever is often caused by cohabitation with native women.

C. B.

The Light Ether Anæsthesia of the Mayo Clinic.—Mrs. Dickinson Berry describes the method of anæsthesia (*Proc. Roy. Soc. Med.*, Section of Anæsthetics, January, 1913, p. 13) adopted at the world-renowned hospital of the Mayos at Rochester, U.S.A. The open-ether plan of administration is that which is used exclusively. Nothing is given beforehand except $\frac{1}{6}$ gr. of morphia in stomach cases. Before beginning the administration the patient is fixed in the position required for the operation, a piece of protective is laid across the eyes, and above this a pad of wool. A modified Esmarch's mask covered with a double layer of stockinet is used. Ether is dropped slowly from a tin fitted with a skein of wool in the cork. In about a minute a long piece of gauze is folded over the inhaler and twisted round the handle; ether is then given more rapidly. During the second stage there are frequently coughing and excitement, but struggling is rare. In about three or four minutes breathing becomes regular, and the surgeon is called. The administration goes on continuously at the rate of a drop every two seconds. Seven to eight minutes is the usual time between the commencement and the first incision. The surgeon disregards slight movements. Mrs. Berry states that the depth of anæsthesia considered sufficient at the Mayo clinic would not satisfy British surgeons. There is not relaxation of the muscles in many abdominal operations, but the use of broad abdominal retractors overcomes this difficulty. In stomach cases ether is discontinued while the viscus is being manipulated. Irregular breathing, coughing, hiccoughing, retching often occur, but do not disturb the operator or the anæsthetist. In two cases which she observed, respiration stopped, but was resumed on drawing forward the tongue, though she states that she saw many instances of slightly obstructed breathing to which no attention was paid. The eyes are covered and are not examined; respiration and pulse in the order of their importance are the guides to the depth of the anæsthesia.

In goitre operations the anæsthesia is lighter than in abdominal; deep anæsthesia is induced for operations in the perinæum or on the kidneys, and for adenoids and cleft palates in children. The amount of ether used varies from 2 oz. in a goitre operation to 5 or 7 oz. in a cholecystectomy. After-sickness is generally slight and ether bronchitis unknown. There has never been a death from anæsthetics in the Mayo's clinic. Nurses are the anæsthetists.

C. B.

A Stable Gram-staining Fluid.—Aniline gentian violet must be freshly prepared, since it undergoes decomposition in a few days. Jensen recently recommended half per cent watery solution of methyl violet as a substitute. Klausner (*Berl. klin. Woch.*, February 17, 1913, p. 310) advises the use of "Haltbarer Gramfarbstoff," prepared by Grubler. He has employed it in hundreds of cases for the detection of the *Spirochæta pallida.* The film is fixed with osmic acid vapour and is stained for a minute over the flame, washed with water and dried.

C. B.

Recent Research on Cholera in India.—Major E. D. W. Greig, I.M.S. (*Ind. Med. Gazette*, January, 1913), has published some results

of his research work on cholera which should have a most important bearing on the prevention of cholera epidemics. From 271 fatal cases of cholera Greig was able to cultivate the cholera bacillus from the bile in eighty cases; twelve of these showed distinct pathological changes in the mucous membrane of the gall-bladder and the comma bacillus was found not only on the surface but in the deeper layers of the mucous membrane.

A number of patients were bacteriologically examined on their discharge from the cholera hospital at Puri; 36 per cent of them were found to be excreting cholera bacilli in their stools. Two convalescents from cholera were found to be excreting vibrios in their stools on the thirtieth and forty-fourth days respectively after recovery from an acute attack. Examination of twenty-seven apparently healthy persons who had been in close contact with cholera patients showed that six were excreting cholera vibrios in their stools. The blood of convalescent carriers gave a positive Widal reaction. An epidemic of cholera was set up in Puri jail by the admission of a cholera carrier. Flies caught during a cholera epidemic were bacteriologically examined, and cholera vibrios were recovered from their external appendages and from the contents of the alimentary canal. The epidemic in Puri jail speedily ceased when a solution of cyllin was placed in the latrine pans; this prevented the access of flies. A fresh solution of chlorinated lime was used in the town latrines; following the adoption of this measure, the number of cholera cases rapidly diminished. C. E. P.

Distance traversed by Anopheles Mosquitoes.—The following note, extracted from the Report of the Department of Sanitation, Isthmian Canal Commission, for the month of November, 1912, throws some further light on the distance which mosquitoes may fly from their breeding place when in search of food:—

"An increase in the number of anophelinæ caught in the northernmost barracks in Gatun occurred in the latter part of the month. A prolonged and careful inspection by the division inspector located the breeding in an area about a mile north of Gatun, in a swamp in the vicinity of Mindi station. Considerable breeding was also found on the hydraulic fill about three-fourths of a mile north of the new Gatun. Steps will be taken immediately to control these areas." C. E. P.

Wounds in the Balkan Campaign.—At a meeting of the k.k. Gesellschaft der Aerzte in Wien, Professor Fraenkel gave a sketch of his experience with the Bulgarians (*Wien. med. Woch.*, No. 6, 1913).

In general the character of the wounds was much the same as those noted in recent campaigns. Wounds of soft parts frequently healed without any inflammation; many compound fractures due to bullet wounds united in much the same way, or even more quickly, than simple fractures. This favourable result is probably largely due to the periosteum being less damaged by a bullet wound fracture than by a simple fracture due to direct violence. Although the general conditions by no means favoured the rapid healing of wounds, the result did not appear to be much influenced by them, but depended more on the treatment adopted. Many of the wounded arrived in hospital without any dressing, in spite of which the wound healed up under a scab. The

worst cases were those in which the wound had originally been plugged. The new pointed bullet showed a great tendency to rotate on its transverse axis during its course, and so strike the man base first. Some of these wounds were characterized by extensive damage to the part struck. Many of the bullets which did not perforate, but remained in the body, were found lying free in a kind of cyst containing chocolate-coloured fluid. Hæmatomata and traumatic aneurysms in many cases did not occur till some two or three weeks after the receipt of the injury, and were apparently caused by the yielding of the damaged vessel wall. At near ranges wounds of vessels caused by the sharp-pointed bullet can barely be distinguished from those caused by the ogival bullet. In bullet wounds of bones strict conservative surgery should be practised. In only one case was resection of bone required, and only two amputations were performed by Fraenkel; in all three cases operative interference was necessitated by the occurrence of severe septic infection. Fraenkel did not see any septic wounds of joints. Tangential wounds of the head had frequently healed by the time they arrived in Sofia, although in many of the cases the bone was damaged; in none of the cases was a dressing applied for at least twenty-four hours after the wound was inflicted. Unless the field hospital is thoroughly equipped for the performance of operations it is wiser merely to apply a dressing to wounds of the skull, and not attempt any operative interference till the patient reaches a base hospital.

Professor Colmers said that in cases of wounds of vessels which were not seen till some days had elapsed, there were frequently no indications that the vessel had been wounded, but that some days or weeks later an aneurysm or hæmatoma suddenly appeared owing to the vessel wall giving way. In a few cases he had sewn up damaged arteries. Colmers's experience with head wounds was not so favourable as Fraenkel's, and he thought that owing to the extensive damage to bone in tangential wounds, they ought to be operated on as soon as possible, provided that surgical facilities were available. Other head wounds might be left alone to await developments.

The unfavourable results were in most cases due to the want of doctors. Bulgaria had only 648 surgeons, of whom only some ten were surgical specialists. After providing for the lines of communication there were not enough surgeons for the front; some regiments had no medical officer at all. Consequently the first dressings were applied by the feldshers (dressers), who only receive a very moderate training.

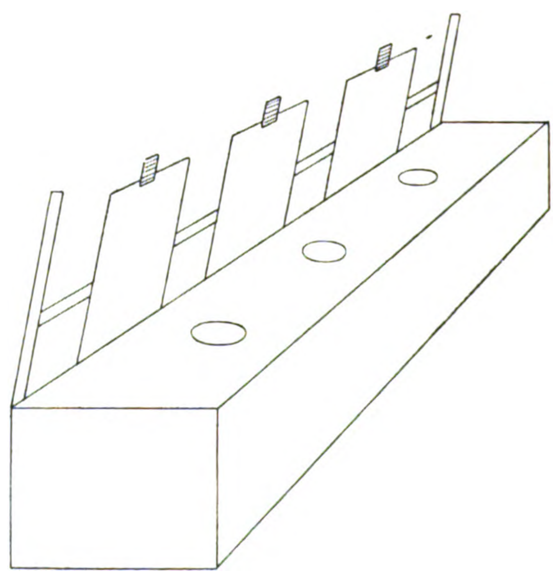
The transport of wounded was carried out by means of ox-wagons; patients were huddled up on the floor on straw without blankets, and remained in the wagon day and night till the journey was completed. No trained attendants were sent with the convoys. Bread and water was the usual food supplied to patients while on the road. Many men must have died during transit to the base. C. E. P.

Balkan War.—*Le Caducée* of February 1, 1913, contains an abstract of a lecture by Professor Lefort on his experiences among the wounded from the Balkan campaign. Lefort states that the proportion of immediately fatal wounds was very high, but that the percentage of complete recoveries among wounded evacuated to the hospitals in rear was also

high. Wounds of the shafts of long bones produced a great deal of splintering, but the fragments remained in position, and good union ensued. Wounds of joints healed up like wounds of soft parts and left no interference with the functions of the joint. Wounds of lung usually healed without giving rise to any serious trouble. A noteworthy proportion of abdominal wounds resulted in recovery. The most unfavourable class of wound was that of the skull. When hit, the men did not as a rule suffer much pain. Shrapnel bullets inflict a nasty contused wound which does not heal well, and has a great tendency to become septic. Lefort states that in the Servian and Bulgarian armies the rule was to evacuate all wounded to base hospitals as soon as possible, and that in spite of the poor roads and uncomfortable means of conveyance the results were satisfactory; very few died on the journey.

C. E. P.

Officers' Latrine.—During the American army manœuvres, 1912, a very satisfactory latrine was used. It consisted of a movable box which was placed over a trench. Lids were provided for each aperture. A pole



fixed along the back of the seat, at an angle of 80 degrees with the latter, ensured that the lids were closed when the seat was not in use. The trench was thus always completely closed, and flies were unable to reach the excreta. The sketch shows the general construction.

C. E. P.

Pignet's Index of Physical Fitness.—Franz (*Militärarzt*, January 18, 1913) read a paper in which he discussed the results obtained by applying Pignet's index to 2,870 recruits enlisted in the Russian Army.

Pignet's index was worked out for each recruit; the number in each group is shown in the Table as a percentage of the total number examined:—

Index:	Negative	0—5	6—10	11—15	16—20	21—25	26—30	31—35 and over
Percentage ..	5·30	13·3	22·0	26·96	21·39	8·82	1·85	0·31
			89·02				10·98	

This shows that 89 per cent would, according to Pignet's index, be classed as of fair to very good physique.

Of the above 2,870 recruits 499 were discharged the Service for disability of one kind or another. Franz took the actual numbers discharged in each of the above groups and worked out the ratio this number bore to the number of men originally enlisted in the group. He found that in the group 31 to 35 the percentage of discharges was 88·8, while in the group 26 to 30 it was only 41·5, and in the remaining groups it varied from 11 to 20 per cent. Of the men belonging to the group having an index of 25 or over, and who remained in the Service a large proportion were constantly sick from some cause. Similarly nearly half the men in the group having an index over 30 were discharged for debility or tubercle. Franz concludes that a high Pignet's index should be regarded as a sufficient cause for the rejection of a recruit on account of poor physique. C. E. P.

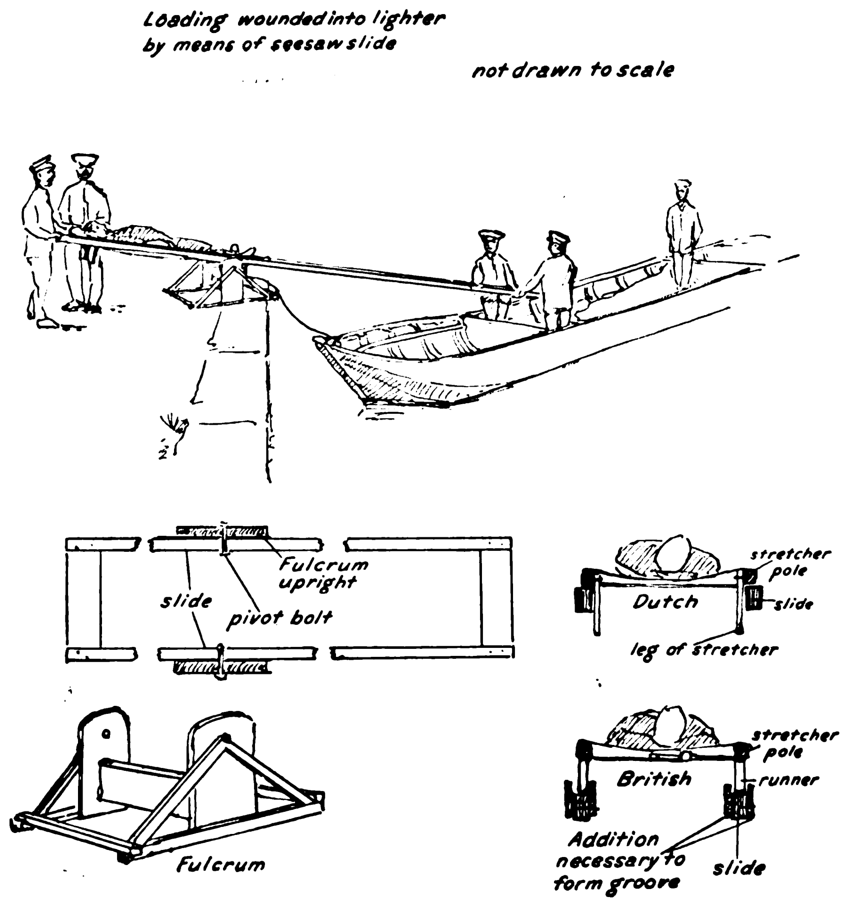
Tincture of Iodine in the Field.—Pharmacien Major A. Gautier (*Arch. Méd. Pharm.*, No. 12, 1912) has been investigating the problem of supplying medical units in the field with tincture of iodine.

He points out that when tincture of iodine is stored it becomes decomposed, hydriodic acid being formed; this change goes on for eight months, when each litre of tincture of iodine (10 per cent strength P.F.) is found to contain 15 grm. of hydriodic acid, which causes great irritation when applied to the skin. Courtot, as a result of his researches, found that by adding 35 grm. of iodide of sodium to each litre of the tincture decomposition of the latter was prevented. The alternative is to make a fresh solution of iodine when required. The volatilized crystalline iodine usually sold requires several hours shaking to dissolve it in 95 per cent alcohol unless iodide of soda is added. Iodine can be obtained in the form of a powder by adding distilled water to a saturated solution of iodine in alcohol. This powder, dried over sulphuric acid, dissolves at once in 95 per cent alcohol. In place of the 200 grm. of tincture at present carried by each *ambulance*, a large supply of powdered iodine could be carried in ampoules each containing either 5 or 10 grm. to make 50 or 100 grm. of the tincture (P.F.). This would largely increase the available supply of tincture, as alcohol is obtainable without any great difficulty. C. E. P.

Loading Wounded into Barges.—H. de Groot, Officier van Gezondheid 2te Kl. (*Mil. geneesk. Tijdschr.*, 1912), in discussing the transport of wounded by water, describes two ingenious ways of loading a canal barge where the surface of the water is lower than that of the bank.

In one method the stretcher is slid into the barge by means of a slide and fulcrum, in the other the stretcher is lowered by means of an extemporized derrick. These methods might be found useful should canals be used for the conveyance of the sick and wounded.

(1) *Method of Loading with the Slide.*—The lighter is prepared by covering the space to be occupied by the patients with canvas (a tarpaulin or sail). This is advisable in the case of lighters used for dirty cargoes. The lighter is swung out across the canal and secured fore and aft to the opposite banks. The patient is taken in over the bows of the lighter. The mechanism used consists of a *slide* or frame made of two long



square pieces of wood joined together at their ends by cross pieces to keep them parallel, and a wooden *stand* or fulcrum to rest on the ground, with two uprights, bored to receive bolts, fastened through the sides of the slide, on which the slide can move up and down as on trunnions. The slide appears to be about 20 ft. long, and two-thirds of its length are on land, the remainder over water, overhanging the boat.

In the sketch the boat is not at right angles to the bank, and the fulcrum stand is turned accordingly.

The width of the slide frame is such as to support both poles of the stretcher, and the legs of the stretcher (which in this pattern are fastened to the inner sides of the poles) come between the sides of the slide and serve to guide the stretcher when it is released.

The loading is carried out by five men: two on shore, three on board the boat.

The patient on his stretcher is placed on the inshore end of the slide, feet towards the boat. Two men on board the boat keep their end of the slide raised.

When it is desired to pass the patient into the boat, the boat end of the slide is lowered, and the stretcher slides down the incline and, with the aid of the third man in the boat, is received and lifted into its place in the boat.

The following appear to be the dimensions and materials of the parts:—

Slide.—Two pieces of larch squared and planed smooth 20 ft. × 4 in. × 3 in. joined at their ends by two pieces of fir 23 in. × 10 in. × 1 in. nailed to their under surfaces. Perforated at 6 ft. 6 in. from one end for the passage of iron bolts (one in each) of ½-in. diameter.

The Fulcrum Stand.—Two pieces of fir or oak 2 ft. × 1 ft. by 1½ in. (shaped as in sketch) for uprights. Connected and supported as in sketch. Perforated 3 in. from their tops for the passage of ½-in. iron bolts. Two 6½in. × ½ inch iron bolts or nuts.

Note.—As the runners of the British stretcher are placed directly beneath the poles, a special modification of the *slide* would be necessary (see sketch).

This modification would consist in the fastening of ½-in. × 5-in. strips of firwood on each side of the slide frames to form a gutter in which the runners would be guided.

(2) *Method by Extemporized Derrick.*—In this case the lighter is brought alongside the bank.

The mechanism consists of an upright post driven into the ground with its larger end uppermost, near (2 ft. from) the bank, which in this case has a retaining wall.

A spar about 20 ft. long, which is lashed to the upper end of the post in such a way as to allow it to be traversed round a quadrant of a circle and to permit of some vertical rocking movement. A pair of double blocks each with a hook, and a tackle of 2½-in. rope—the upper block to be fastened by a lashing to the shorter end of the spar.

A single block with a ring or hook to be lashed to the lower end of the upright post close to the ground. Two pieces of small rope (1½ in.) knotted, as in the sketch, to form a sling for the stretcher, four looped ends of equal length radiating from a double loop.

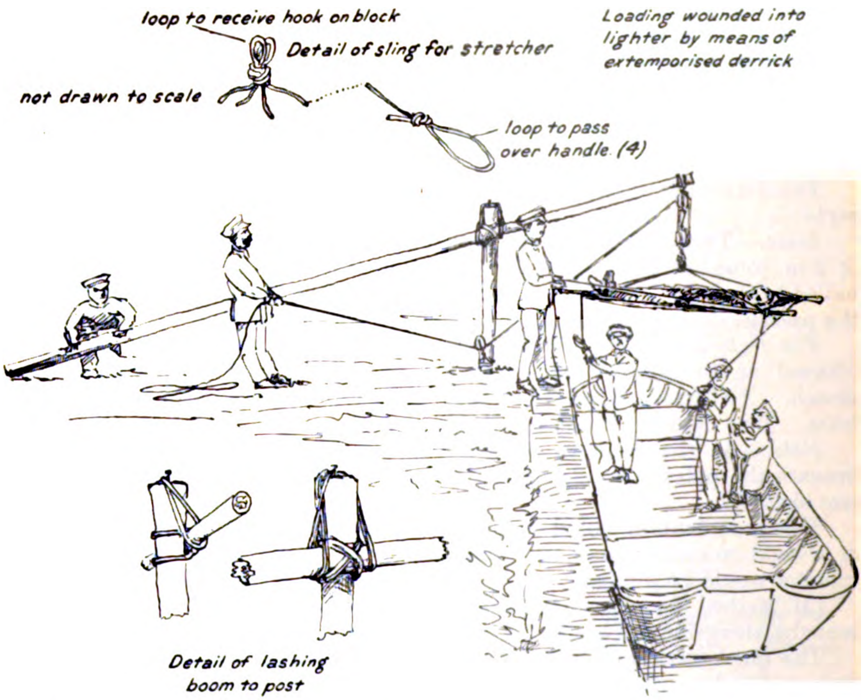
The double loop to be attached to the lower double block, and the four radiating ropes to be passed to the four stretcher handles, and their loops placed over the handles.

Some four pieces of small rope to be passed over the handles of the stretcher to guide it while it is suspended.

Method of Loading.—Six men are depicted, three ashore and three in the lighter.

The spar is traversed so as to be parallel with the bank.

The wounded man on the stretcher is placed beneath its shorter limb, the ends of the rope sling are passed over the handles, and the lower block is hooked through the central loop and the tackle hauled tight; the rope guides are fixed to the stretcher handles. One man takes charge of the tackle, which is rove through the single block (see sketch).



One man stands to the long limb of the spar and sees to the traversing and its steadiness.

One man stands to the stretcher and gives directions and assists in guiding the stretcher from the shore into the boat.

When all is ready to load the tackle-man hauls on the tackle till the stretcher is raised from the ground, the traverser in the meantime keeping the spar down. The traverser, on the direction of the third shore man, brings the long end of the spar round till the stretcher overhangs the boat and then keeps the spar steady on the ground.

Guide ropes are handed to the men in the boat and the order is given to lower, when the tackle-man pays out, and the stretcher is received and put into its place.

The parts and the dimensions are approximately :—

One larch or other wood stake, 6 ft. 6 in. × 6 in., to be driven 1 ft. 6 in. into the ground.

One larch spar 20 ft. × 5 in. tapering to 3½ in. (a barge sprit would do).

Two double blocks to take 2½-in. rope, with hooks.
One single do.
60 ft. of 2½-in. hemp rope for tackle.
60 ft. of 1½-in. hemp rope for guide ropes and slings.
30 ft. of small preferably tarred lanyard for lashings.
4 in. nail to fix in head of post.
The apparatus is prepared thus :—

The stake is planted in the ground, smaller end downwards; 5 ft. 6 in. appear above ground.

The small single block is fastened to it by lashing, where it emerges from the ground. A lashing is fastened to the smaller end of the long spar to receive the hook of the upper double block.

The longer spar is lashed by means of a diagonal lashing to the upright and slung by taking turns over the head of the stake which must be left square.

A 4-in. nail should be driven 2 in. into the centre of the stake to keep the turns from slipping. The lashing should permit of some movement. At least four turns of lanyard should be used to each supporting loop.

The blocks are hooked on and the tackle is rove and carried through the single block.

The sling for the stretcher is prepared by cutting two pieces of the 1½-in. rope into two equal lengths, each of about 12 ft. These are laid together, doubled, and the loop-ends tied in a knot so as to leave a double loop; the four free ends are each tied in a loop, great care being taken to make them of equal length. The loops must be large enough to go over the stretcher handles.

H. E. R. J.

Correspondence.

MARKING OF HOSPITAL UTENSILS.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I was reading an interesting article in the *British Medical Journal* of February 1, 1913, on John Haygarth. On p. 240, Rule VIII, for "Fever Wards," occurs the rule ". . . pots, cups, and other utensils are to be of a peculiar colour, lest they be inadvertently taken amongst other patients." This sentence, it seems to me, applies mainly to us in India. At the present time the rule is for enteric, infectious and the various forms of venereal patients to have their utensils marked in a sealing-wax compound with their respective letters, E., I., G., S., &c.; this marking invariably washes off in a very short time and has constantly to be renewed, and it is continually a matter of annoyance to find that utensils in use are devoid, or half devoid, of proper lettering. A trivial matter, no doubt, yet I think that if Haygarth's idea of different coloured chinas were introduced, which would cost the authorities very

little, it would prove a great advantage; say, red for enteric, green for infectious, and some other colours or bands for venereal patients. Ward boys and others would at once see that they were different from the rest of the crockery in the wards.

I am, &c.,

Kamptee, J. H. BARBOUR,
February 19. 1913. *Major, R.A.M.C.*

OBSERVATIONS ON THE VALUE OF CERTAIN CHEMICALS FOR THE STERILIZATION OF WATER.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—As I have spent some considerable time in investigating the value of chlorine as a means of sterilization of water, I feel bound to draw attention to some errors which appear in the above article in this month's Journal.

In the first place the silver nitrate method only estimates the combined chlorine in the chloride of lime and not the free chlorine. The arsenious acid and iodine method should have been used.

In the second place the author's arithmetic is surely very much at sea. Having found 0·3 part of free chlorine in one gramme of the chloride of lime powder, he then states that a solution of 3 grammes of chloride of lime in 10 c.c. of water contains 0·3 part of free chlorine in each cubic centimetre, whereas it only contains 0·09 part.

Again, it is stated further on that 0·003 c.c. of this solution of chloride of lime in 10,000 c.c. of water makes a dilution of 0·3 part per million, whereas it only makes a dilution of 0·027 part per million. No wonder that this dilution was found subsequently to be useless for the sterilization of water.

It is unfortunate that a method of water sterilization which has been found efficient under certain circumstances should be brought into discredit by such a report as this.

Royal Army Medical College, I am, &c.,
London, S.W. H. B. FAWCUS,
March 17, 1913. *Major, R.A.M.C.*

No. 5. May, 1913. Vol. XX.

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL W. H. HORROCKS,

ROYAL ARMY MEDICAL CORPS

ASSISTED BY

MAJOR C. E. POLLOCK,

ROYAL ARMY MEDICAL CORPS

ISSUED MONTHLY

Printed and Published by

JOHN BALE, SONS & DANIELSSON, LTD.

OXFORD HOUSE,

83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W.

Price Two Shillings net.

VOLUME XX. MAY, 1913. No. 5.

Journal

of the

Royal Army Medical Corps.

Original Communications.

A PRELIMINARY NOTE ON THE DIFFERENTIATION OF STAPHYLOCOCCI.

BY MAJOR S. L. CUMMINS AND MAJOR C. C. CUMMING.
Royal Army Medical Corps.

IN the course of an investigation on the bacterial content of fresh vaccine lymph it became our duty to attempt to differentiate the various strains of staphylococci isolated, with a view to certain immunization experiments which were the actual object of our research. We do not propose, at present, to deal with the latter subject, but we are constrained to publish the results of our attempt at a differentiation of the staphylococci as we think that they may have a practical bearing on vaccine therapy, especially where it is a question of using stock vaccines. It is, of course, the case that the organisms which we worked with represented the types present upon the epidermis of calves, and were not necessarily the same as human types; in fact the *Staphylococcus epidermidis albus* was conspicuously rare in our series. Still the fact that we were able to draw a clearly marked line between certain organisms morphologically similar and of the same colour-type may be taken, at least, to raise the question of the invariable identity of the various strains of white staphylococci used in the preparation of stock staphylococcus vaccines for treatment.

M. H. Gordon (Reports of the Local Government Board, 1903-04 and 1905-06) has claimed a very decided value for certain cultural tests in the differentiation of both staphylococci and streptococci

from various (chiefly human) sources. His results, while confirmed by some, have been criticized by more recent workers,[1] at least so far as the streptococci are concerned. Without claiming that the conclusions arrived at as to the staphylococci of calves are applicable to those of man, we may mention that, in our hands, the cultural tests of Gordon have proved unreliable. The serological work of Dudgeon[2] appeared to us more likely to furnish satisfactory results, and our work has confirmed this opinion, but it is very necessary to bear in mind the part played by "group" reactions in the serological responses of these closely allied organisms, a point likely to give rise to confusion unless the further aid of Castellani's absorption test be invoked when in doubt. The cultural tests recommended by Gordon and used by us were as follows: Character of the growth in broth, as to whether diffuse or showing deposit, liquefaction or otherwise of gelatine, acidification of lactose, maltose, mannite, and glycerine, the clotting of milk and peptonization of the clot, the conversion of nitrate to nitrite and the production of a yellow colour in neutral red under anaerobic conditions. It was exceptional to meet with staphylococci which failed to liquefy gelatine or to acidify lactose. Milk, too, was almost invariably clotted and in most cases peptonized. The degree to which peptonization took place, however, was very variable, and we were occasionally in doubt as to whether peptonization had occurred or not. The same might be said of the reactions in glycerine and in neutral red, these being sometimes ill-defined, though usually distinct. Our only criticism of these tests, apart from these trifling difficulties, is the serious one that the results were not constant on repetition of the tests two months later.

PART I.

Cultural Tests.

The pooled lymph of ten calves was "plated" each week for ten weeks, a number of single colonies of representative types being sub-cultured, on each occasion, which furnished the strains used in this research.

With the exception of one large coccus which grew in tetrads, and two small cocci which grew feebly on agar, failed to liquefy

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[1] Captain L. W. Harrison, Journal of the Royal Army Medical Corps, vol. xiii, p. 515, 1909

[2] *Journal of Pathology and Bacteriology*, vol. i, p. 243, 1908.

gelatine and soon died out, all the colonies on the plates were staphylococci, and the distribution of colour over a long series of examinations showed 70 per cent of yellow and orange to 30 per cent of white and grey. One hundred colonies (47 white and 53 yellow) were submitted to the tests advocated by Dr. Gordon, and after two months were re-examined to see whether the cultural reactions remained unchanged. The results are given for the white strains in Table I, for the yellow in Table II.

It will be seen that the 47 white colonies fell into no less than twenty-four categories in the first examination, while the 53 yellow strains showed 23 variations. Two of the whites and three of the yellows died out on subculture and were not examined a second time. It appeared unlikely that these wide variations in culture represented true differences in biological character, as while some of the tests gave clear and unmistakable reactions, others were so uncertain that we often hesitated whether to interpret the result as positive or negative. We thought, however, that by selecting a few of the more important tests we might arrange the cocci into groups displaying more or less constant characters. We divided them into five groups as follows:—

Group I.—No acidity in maltose or mannite.

Group II.—No acidity in maltose. Acidity in mannite.

Group III.—Acidity in maltose. No acidity in mannite.

Group IV.—Acidity in both maltose and mannite.

Group V.—Gelatine not liquefied.

It may be mentioned that the organisms failing to liquefy gelatine were much less vigorous than the members of the first four groups, two out of five amongst the whites, and three out of four amongst the yellows, dying out on subculture, while all the ninety-one members of the first four groups survived.

The second examination, carried out ten weeks after the first, showed that the cultural characters were by no means stable, only 11 out of the 45 surviving whites remaining unchanged, while 34, or 75 per cent, varied from their first "type." Amongst the 50 surviving yellow cocci 14 only retained their characters, 36, or 72 per cent, altering in some respect. Naturally the number of organisms passing into a different *group* on the second examination was much smaller, 14 out of 45 whites, and 15 out of 50 yellows, or about 30 per cent in each case, altering so far as to enter a new group. This, however, was quite sufficient to show that even the groups were unstable in character, and not suitable as a basis for

differentiating these staphylococci. It will be noticed, however, that both in the case of the white and yellow cocci there was a tendency to pass from other groups into Group I. In fact, the tendency was to greater uniformity in the second examination, 45 organisms showing 14 varieties amongst the whites, as compared with 47 strains with 24 varieties on first culture, and 50 organisms showing 16 varieties amongst the yellow, as compared with 53 organisms with 23 varieties in the first examination.

Two considerations must be mentioned as perhaps helping to explain the great variation between the results of the first and second series of tests. (1) In a certain number of cases a few small secondary colonies of a different colour appeared after two months' keeping of the sealed agar slope cultures. We did not see any white colonies appear on cultures of yellow staphylococci, but in a certain number of cases a few small yellow colonies appeared upon the surface of the white staphylococcus cultures. Whether these were the results of variation by individual cocci, or whether a very small number of yellow cocci were present in the original culture we are unable to say. All our strains were originally derived from single colonies, but where there is no mutual antagonism between organisms it is conceivable that what appears to be a single colony may be, in reality, a colony in which a majority of one type obscures the visibility of a small but definite minority of another. In the case of subculture of such a colony into a fluid medium containing a substance fermentable by only one of the types, the type capable of fermenting the medium would tend to outgrow the other even where the initial numerical value of the former was comparatively insignificant.

In the second series of tests we invariably avoided the "secondary" yellow colonies, so that the strains may have been purer on the second occasion. This view receives some support from the fact that there was, as above mentioned, a tendency to greater stability of type on the second testing; but since this tendency is also to be noticed amongst the yellow strains, where secondary colonies did not appear, too much stress must not be laid upon it. (2) Another point is that instead of using our reagents in test tubes, we economized both time and media by adopting the method, devised by Captain (now Major) L. W. Harrison,[1] of culture in sterile pipettes. This method, while greatly facilitating the work, may perhaps have occasionally been responsible for some

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[1] Journal of the Royal Army Medical Corps, vol. xiii, p. 515, 1909.

TABLE I.—Cultural Reactions (Gordon's Tests): White Staphylococci.

	Colour	Shape	Growth in broth	Gelatin	Lactose	Maltose	Mannite	Nitrate to nitrite	Milk clotted	Milk peptonized	Glycerine	Neutral red	First examination	Second examination
Group I.—White	(a) White..	Coccus	Diffuse ..	+	+	−	−	+	+	+	+	−	39, 29, 47, 50,* 31, 65, 63,* 27	39,† 29,† 47,† 31,† 27,† 24, 19, 69, 35, 14, 41, 59, 43, 6‡
	(b) ,, ..	,,	,, ..	+	+	−	−	+	+	+	+	+	12,* 24,* 16,* 19,* 69,* 82,* 10	10,† 50, 63, 67, 45
	(c) ,, ..	,,	,, ..	+	+	−	−	+	+	+	−	−	35,* 14,* 41	101,‡ 79‡
	(d) ,, ..	,,	,, ..	+	+	−	−	+	+	+	−	+	57*, 59,* 67,* 45,* 84	84, 82, 61, 8, 40,‡ 73‡, 75‡, 80,‡ 77,‡ 95‡
	(e) ,, ..	,,	,, ..	+	+	−	−	−	+	+	+	−	61*	—
	(f) ,, ..	,,	,, ..	+	+	−	−	−	+	+	−	+	8*	—
	(g) ,, ..	,,	,, ..	+	+	−	−	−	+	+	−	−	43*	—
Group II.—White	(a) ,, ..	,,	,, ..	+	+	−	+	−	+	+	+	−	40*, 101*	57‡
	(c) ,, ..	,,	,, ..	+	+	−	+	+	+	+	−	+	—	12,‡ 93‡
Group III.—White	(a) ,, ..	,,	,, ..	+	+	+	−	+	+	+	+	+	71, 73,* 75,* 80,* 4	—
	(b) ,, ..	,,	,, ..	+	+	+	−	−	+	+	+	+	77*	—
	(g) ,, ..	,,	,, ..	+	+	+	−	+	+	+	+	−	—	16,‡ 4
Group IV.—White	(a) ,, ..	,,	,, ..	+	+	+	+	−	+	+	+	+	90, 92, 95	—
	(b) ,, ..	,,	,, ..	+	+	+	+	+	+	+	+	−	87, 91	87†
	(c) ,, ..	,,	,, ..	+	+	+	+	+	+	+	+	+	79	92
	(d) ,, ..	,,	,, ..	+	+	+	+	−	+	+	−	−	93	—
	(e) ,, ..	,,	,, ..	+	+	+	+	+	−	−	+	−	88	88†
	(f) ,, ..	,,	,, ..	+	+	+	+	+	−	+	+	−	—	90
	(g) ,, ..	,,	,, ..	+	+	+	+	+	−	−	−	+	—	91
Group V.—White	(a) ,, ..	,,	,, ..	−	+	+	+	+	+	+	−	−	97,* 99*	—
	(b) ,, ..	,,	,, ..	−	+	+	+	+	+	+	−	−	6*	—
	(c) ,, ..	,,	,, ..	−	+	+	+	+	−	−	+	+	54. Died out	—
	(d) ,, ..	,,	,, ..	−	+	+	−	−	−	−	−	+	56 ,,	—
	(e) ,, ..	,,	,, ..	−	+	−	−	+	+	+	−	−	—	97, 99

* Altered on second culture. † Unaltered on second culture. ‡ Transferred to another *group* on culture.

TABLE II.—CULTURAL REACTIONS (GORDON): YELLOW STAPHYLOCOCCI.

	Colour	Shape	Growth in broth	Gelatin	Lactose	Maltose	Mannite	Nitrate to nitrite	Milk clotted	Milk peptonized	Glycerine	Neutral red	First examination	Second examination
Group I.—Yellow	(*a*) Yellow	Coccus	Diffuse ..	+	+	−	−	+	+	+	+	−	98,* 11, 13, 15, 48*	11,† 13,† 15†
	(*b*) ,, ..	,,	Diffuse or deposit	+	+	−	−	+	+	+	+	+	83*	58, 60, 7, 21‡
	(*d*) ,, ..	,,	Diffuse or deposit	+	+	−	−	+	+	+	−	+	58,* 60,* 7,* 18	18,† 98, 48, 83, 52,‡ 86,‡ 76,‡ 74,‡ 78,‡ 96,‡ 100‡
	(*e*) ,, ..	,,	Diffuse ..	+	+	−	−	−	+	+	+	−	33*	—
	(*g*) ,, ..	,,	,, ..	+	+	−	−	−	+	+	−	−	44*	—
	(*h*) ,, ..	,,	,, ..	+	−	−	−	−	−	−	−	+	53	53
	(*i*) ,, ..	,,	,, ..	+	+	−	−	+	+	+	−	−	—	44
Group II.—Yellow	(*b*) ,, ..	,,	Diffuse or deposit	+	+	−	+	+	+	+	+	−	37, 49, 51, 52*	37,† 49,† 51,† 20
	(*c*) ,, ..	,,	Diffuse or deposit	+	+	−	+	+	+	+	−	+	20,* 21,* 23*	85,‡ 34,‡ 46,‡ 94‡
	(*d*) ,, ..	,,	Diffuse ..	+	+	−	+	+	+	+	+	+	86*	23
Group III.—Yellow	(*a*) ,, ..	,,	Diffuse or deposit	+	+	+	−	+	+	+	+	+	55,* 62,* 68,* 70,* 74,* 78,* 76,* 85,* 71,* 66, 34*	66,† 3, 72, 42, 9
	(*b*) ,, ..	,,	Diffuse or deposit	+	+	+	−	+	+	+	−	+	3,* 17,* 72*	55, 62, 70, 71, 81‡
	(*c*) ,, ..	,,	Diffuse or deposit	+	+	+	−	+	+	+	+	−	30, 36, 46*	36,† 17, 30
	(*d*) ,, ..	,,	Diffuse or deposit	+	+	+	−	−	+	+	−	−	1, 42*	1†
	(*e*) ,, ..	,,	Deposit ..	+	+	+	−	−	+	+	+	−	64*	—
	(*f*) ,, ..	,,	Diffuse ..	+	+	+	−	−	+	+	−	+	9*	—
	(*g*) ,, ..	,,	,, ..	+	+	+	−	−	+	+	+	+	—	68, 102‡
Group IV.—Yellow	(*a*) ,, ..	,,	Diffuse or deposit	+	+	+	+	−	+	+	+	−	94,* 96,* 100* 102*	64‡
	(*c*) ,, ..	,,	Diffuse ..	+	+	+	+	+	+	+	+	+	28, 32, 81*	28,† 32†
Group V.—Yellow	(*e*) ,, ..	,,	Diffuse or deposit	−	−	−	−	−	−	−	−	−	25, 26, 89. Died out	—
	(*f*) ,, ..	,,	Deposit ..	−	+	−	−	−	+	+	−	+	5*	—
	,, ..	,,	,, ..	−	+	+	−	+	+	+	+	+	—	5

* Altered on second culture. † Unaltered on second culture. ‡ Transferred to another *group* on culture.

doubt as to whether a badly marked reaction was positive or negative. It appears that slight changes in colour are more easily detected in fairly large volumes of fluid than in smaller ones. But making all allowances for the above possible sources of error, the fact remains that the cultural reactions were found to be unreliable as a means of differentiating the staphylococci under examination, and we were obliged to turn to serological methods to further our investigation.

PART II.

Serological Tests.

Five groups, each consisting of three rabbits, were chosen and treated as follows :—

Group I was retained as a "control" and given no inoculations.

Group II was inoculated with white staphylococcus "No. 39" (*vide* Table I), receiving one-tenth of an agar slope (heated to 60° for quarter of an hour) on January 19, 1912, and similar doses of *unheated* emulsion on January 29, 1912, February 9, 1912, and February 18, 1912.

Group III was inoculated with yellow staphylococcus "No. 37," receiving one-tenth agar slope (heated) on January 19, 1912, and similar doses of an unheated emulsion on January 29, 1912, February 9, 1912, and February 18, 1912.

Group IV was inoculated with yellow staphylococcus "No. 11," receiving doses as in the previous groups on the same dates.

Group V was inoculated with white staphylococcus "No. 4," receiving the same doses as previous groups on the same dates.

The serum of the rabbits of each group was drawn as required, "pooled" to minimize error, and examined at intervals as to its content in "thermostable opsonin" for the homologous and other organisms, as we hoped in this way to establish or disprove the biological identity of the four organisms under examination.

It will be seen in the annexed opsonic tables that the "Anti-39" serum possessed high opsonic power for "strain 39," and that the opsonins were *specific*, inasmuch as they were without effect on the two yellow staphylococci (17 and 11), or the heterologous white staphylococcus (4).

Further, the "Anti-39" serum opsonized strain 82, a white staphylococcus of cultural reactions similar to strain 39, to the same extent as it opsonized strain 39 itself, and absorption of "Anti-39" serum with either strain 39 or 82 removed all opsonins for *both* organisms, while absorption with strain 11 (yellow) removed none

of the opsonins for strains 39 or 82, and absorption with strain 4 (white) only partially removed them.

It was clear then that strains 39 and 82 were identical and that strains 37, 11, and 4 were specifically different from strains 39 and 82.

At the same time the attempts to produce immune substances for the homologous organism by inoculations of strains 37 and 4 had completely failed, and thermostable opsonins for strain 11 had only been produced in small quantity and with difficulty.

At this point the important discovery was made that "Anti-39" serum possessed considerable agglutinating power for strains 39 and 82. We had not expected to obtain much help from agglutinins, as the characteristic grouping of staphylococci in a "hanging drop" is difficult to distinguish from a "clump" of the organism resulting from the action of a specific serum; but we found that a homogeneous emulsion of strain 39, while normally remaining in suspension for many hours, was almost instantaneously cleared by the addition of "Anti-39" serum, the organisms being precipitated in heavy aggregations. We at once subjected the sera of the other "groups" to examination on similar lines, using each serum in dilutions from 1 in 4 to 1 in 100 against its corresponding organism as well as several others. The results are shown in the "Agglutinin Chart A," where it will be seen that the only serum showing marked agglutinating powers was "Anti-39 serum." This serum agglutinated four out of the five white strains examined in dilutions of 1 in 50 and one yellow strain (49) to a similar degree, while it agglutinated yellow strain 11 and white strain 4 in low dilutions. It had absolutely no agglutinating effect on the yellow strain 37. "Anti-11 serum" agglutinated yellow strain 11 up to 1 in 20 and partially in 1 in 50 dilution, while "Anti-4 serum," although agglutinating strains 11 and 39 in low dilutions, had no effect whatever on its homologous strain 4. "Anti-37 serum" agglutinated its corresponding strain in 1 in 4 dilution, but no further, and had no effect on strains 11, 39, or 4, though it showed some irregular and doubtful agglutination with the white strains 27 and 35 in 1 in 10 and 1 in 20 dilutions, failing to agglutinate them in the stronger concentration of 1 in 4.

It was clear that "group" agglutination was likely to obscure the results of any research conducted on these lines with a view to separating these stapylococci, and we decided to employ the absorption test of Castellani for this purpose. In carrying out this test, we were obliged to limit our research to the settling of the main

points under discussion—i.e., whether all the staphylococci in calf's "lymph" are identical or whether there are specific differences between (*a*) the colour groups, and further (*b*) between different strains of staphylococci of the same colour. To effect a complete differentiation of the staphylococci under examination would have entailed, in the first place, more time than was at our disposal, and, in the second, the successful production of specific antibodies in experimental animals for each individual strain to be examined. As will be seen from the opsonic and agglutination charts we had failed to produce appreciable immune substances in the case of strains 37 and 4, while in the case of yellow strain 11 the immune substances were small in amount and only produced with difficulty. We decided, therefore, to limit our research to the examination of "Anti-39" serum with reference to (*a*) differentiation of white from yellow strains, and (*b*) of different white strains from each other, should such differentiation be possible. It should be mentioned that while deciding to classify into white and yellow, we had been alive to the fact that the terms covered several gradations of colour; for instance, some of our white strains were not the same opaque white as others, inclining rather to grey, while the yellows again might have been further subdivided into orange, pale orange and lemon had we been fastidious as to minute shades of colour-difference. We noted, however, against certain of the white that they tended to a greyish tone, and it was fortunate that we made this note as we subsequently found that the distinction was significant.

Our first task was to ascertain whether *all* our white strains agglutinated with "Anti-39" serum. We found that they did so with the following exceptions:—

Strains 10, 12, 54, 71, 87, 88, 90, and 92.

The next step was to find out whether all the white strains absorbed the specific agglutinins from "Anti-39" serum. The method employed was as follows: The serum was diluted to 1 in 5. About 2 c.c. of this dilution was thoroughly mixed into a thick emulsion with the organism under examination, allowed to stand for two hours at a temperature of 37° C., centrifugalized, and the clear fluid once more rubbed into an emulsion with a fresh supply of the same organism, being allowed to stand in contact with it at room-temperature until next morning.

The emulsion was again "cleared" by means of the centrifuge and was now ready for testing as to whether "absorption" of specific agglutinin had taken place. For this purpose it was tested

to see whether it still agglutinated strain 39, the organism which had been used to produce the serum.

This method was applied to forty-one strains of white staphylococci, including six that had been described as *greyish white.* Of this number, the majority, twenty-six in all, completely removed all specific agglutinins from "Anti-39" serum. *None* of the six "greyish" organisms removed the agglutinins specific for strain 39. Eight out of the fifteen white or grey staphylococci which failed to "absorb" this serum were derived from "rabbit lymph," not from calf lymph. Of the twenty-six strains that completely absorbed the "Anti-39" agglutinins, twenty-five had been placed in "Group I," on either first or second culture, that is to say, had failed to form acid either in maltose or mannite. Of the fifteen strains that did not absorb the Anti-39 agglutinins, only one had been placed in Group I, and this strain (79) had been transferred to Group IV on the second cultural examination. It would seem, then, that the biological and cultural characters of these organisms go together to some extent. The fact that all the greyish strains failed to absorb the specific agglutinins is a point of interest.

We now turned to the yellow strains and tested fifteen of them in the same way. Of these ten were agglutinated in 1 in 3 dilution of "Anti-39" serum, five being quite unaffected by it. On applying the absorption test, not one of the fifteen strains was able to absorb the "Anti-39" agglutinins from this serum.

The question now was whether these serological characters were as variable as the cultural characters had proved to be. To settle this point, thirty-three white staphylococci were selected, twenty-three of which were found to absorb "Anti-39" serum and ten of which failed to do so. These strains were put aside for two months and then tested again in the same way. On the second examination, the same twenty-three strains absorbed and the same ten failed to absorb the specific agglutinins as on the first occasion. (*Vide* Absorption Table B.)

From the above results it may be concluded (1) that colour is a matter of specific importance, the yellow and greyish strains being distinct from the average opaque white staphylococcus, and (2) that while the majority of the white strains are essentially the same, there are certain exceptions which can be constantly ruled out by absorption tests. A difficulty is that some staphylococci, such as strain 4 and strain 37, are very inefficient as antigen and fail to evoke either opsonins or agglutinins in appreciable amount, so that the absorption test cannot be universally applied to differentiate staphylococci.

In conclusion, we wish to express our thanks to Dr. Blaxall, Medical Superintendent of the Government Lymph Establishment, for his great kindness in furnishing us with material for the work above recorded, as well as with most valuable help in the course of the research, and to Dr. Dudgeon who kindly gave us the benefit of his experience and advice at the beginning of our work.

OPSONIC INDICES: CHART "A."

		Average number of cocci in *each* phagocyte, in the case of strains—		
		39	37	4
"Anti-39" serum ..	Dilution .. $\frac{1}{3}$	25·0	0·4	0·08
	$\frac{1}{15}$	3·48	0·12	0·56
	$\frac{1}{75}$	2·52	0·32	0·16
"Anti-37" serum ..	" .. $\frac{1}{3}$	1·28	0·0	2·2
	$\frac{1}{15}$	0·6	0·0	0·4
	$\frac{1}{75}$	0·4	0·28	0·28
"Anti-4" serum	" .. $\frac{1}{3}$	2·4	0·24	1·64
	$\frac{1}{15}$	0·24	0·08	0·64
	$\frac{1}{75}$	0·4	0·08	0·08
Control serum	" .. $\frac{1}{3}$	1·72	0·04	0·36
	$\frac{1}{15}$	1·48	0·4	0·0
	$\frac{1}{75}$	—	0·32	—

It is seen that only "Anti-39" serum had significant opsonic properties for the homologous strain.

The serum was a "heated" one, so contained only thermostable opsonins.

OPSONIC INDICES: CHART "B."

	Average number of cocci in each phagocyte, in the case of the following strains:—							
	39	37	11	4	82	51	96	71
"Anti-39" serum ..	16·84	0·08	0·52	0·48	20·68	..	..	..
"Anti-37" serum ..	0·12	0·0	0·48	0·2	..	0·16	..	..
"Anti-11" serum ..	0·0	0·16	0·0	0·4	..	..	2·16	..
"Anti-4" serum ..	0·24	0·28	0·12	0·28	..	..	..	0·4
Control serum ..	0·6	0·04	0·48	0·08	..	..	..	..

The above Chart shows that only in the case of "Anti-39" serum were thermostable opsonins produced for the homologous strain. These acted equally well on strain No. 82, belonging to the same cultural "group."

Opsonic Absorption: Chart "C."

	Strain	Average number of cocci per phagocyte, in the case of each of the following strains:— 39	82	11	4
"Anti-39" serum *absorbed* with	39	0·0	0·8	0·36	0·2
	82	0·08	0·24	0·0	0·36
	11	5·0	4·5	0·4	0·8
	4	2·16	1·7	0·08	1·28

The Chart shows that "absorption" of "Anti-39" serum with strains 39 and 82 removed all thermostable opsonins from the serum. Absorption with the yellow strain 11 had no effect, and with the white strain 4 only a partial effect. The opsonic titre of the serum was low at this date.

Agglutinin Chart "A."

Agglutinins (for 8 strains) in Rabbit Sera.

Serum	Strains	Serum dilutions $\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{50}$	$\frac{1}{100}$	
Control serum	11	−	..	..	..	..	11, 49, and 37 = yellow.
	49	−	..	..	..	..	
	27	−	..	..	..	..	
	35	−	..	..	..	..	
	4	−	..	.	..	..	
	39	−	..	..	..	..	
	31	−	..	..	..	..	
	37	−	..	..	..	..	
"Anti-39" serum	11	+	+	−	−	−	It is seen that "Group Anti-39" serum agglutinated four white strains and one yellow (49) to $\frac{1}{50}$ and over.
	49	+	+	+	+	±	
	27	+	+	+	+	+	
	35	+	+	+	+	±	
	4	−	..	±	..	..	
	39	+	+	+	+	±	
	31	+	+	+	+	−	
	37	−	−	−	−	−	
"Anti-37" serum	11	−	−	−	−	−	
	49	−	..	−	−	−	
	27	−	+	−	−	−	
	35	−	+	+	−	−	
	4	−	−	−	−	−	
	39	−	−	−	−	−	
	31	−	−	−	−	−	
	37	+	−	−	−	−	
"Anti-11" serum	11	+	+	+	±	−	Agglutinins for strain 11 were produced in "Anti-11" serum, but only to $\frac{1}{50}$.
	49	−	−	−	−	−	
	27	+	−	−	+	−	
	35	−	−	−	−	−	
	4	−	−	−	−	−	
	39	+	−	−	−	−	
	31	−	−	−	−	−	
	37	−	−	−	−	−	
"Anti-4" serum	11	+	+	+	−	−	
	49	−	−	−	−	−	
	27	−	−	−	−	−	
	35	±	−	−	−	−	
	4	−	−	−	−	−	
	39	+	+	−	−	−	
	31	−	−	−	−	−	
	37	−	−	−	−	−	

ABSORPTION TABLE "B."

	First Examination				Second Examination			
	Strains aggluti-nated by "Anti-39" serum	Strains not agglu-tinated by "Anti-39" serum	Strains absorbing aggluti-nins from "Anti-39" serum	Strains *not* absorb-ing agglu-tinins from "Anti-39" serum	Strains agglu-tinated by "Anti-39"	Strains not agglu-tinated by "Anti-39"	Strains absorbing "Anti-39"	Strains *not* ab-sorbing "Anti-39"
White ..	4, 8, 14, 16, 24, 27, 29, 31, 39, 41, 43, 45, 59, 61, 63, 65, 67, 73, 75, 77, 80, 84, 91, 93, 95, 101	12, 40, 54, 87, 88, 90, 92	8, 14, 16, 24, 27, 29, 31, 39, 41, 43, 45, 59, 61, 63, 65, 67, 73, 75, 77, 80, 93, 95, 101	4, 12, 40, 54, 87, 88, 90, 91, 92, 96	8, 14, 16, 24, 27, 29, 31, 39, 40, 41, 43, 45, 59, 61, 63, 65, 67, 73, 75, 77, 80, 91, 93, 95, 101	4, 12, 54, 87, 88, 90, 92, 96	8, 14, 12, 24, 27, 29, 31, 39, 41, 43, 45, 59, 61, 63, 65, 67, 73, 75, 77, 80, 93, 95, 101	4, 12, 40, 54, 87, 88, 90, 91, 92, 96

AN INTERESTING CASE OF KALA-AZAR.

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Quite recently I have had an opportunity of studying a case which presented such a number of interesting features that I have thought it worth while recording them.

The patient was a young Arab, aged 20, and at the time of his illness was serving a term of imprisonment in Khartoum.

Previous History.—Up to the time of his admission to the prison he had resided along with his relations for seven years at Singa, an out-station located in one of the Kala-azar districts of the Sudan. During his sojourn there he had, two years ago, a few attacks of epistaxis and a bout of fever which lasted for a week; otherwise he had always enjoyed perfect health.

Family History.—His father, sister, and three uncles died in Singa from the effects of a fever of about three months' duration. The patient could give no details as regards the nature of this fever.

Present Illness.—The patient was transferred from Singa to Khartoum in October, 1911, and remained in good health till the early part of January, 1912. On January 14 he was admitted to the prison hospital suffering from epistaxis and fever. The writer did not have an opportunity of seeing the case till February 29. The patient at that time was in a very weak state resulting from repeated attacks of epistaxis and a continued fever. A careful clinical examination was carried out, but, apart from an enlarged spleen and liver and a certain degree of anæmia, nothing further could be detected. The splenic enlargement extended down to the umbilicus, while the liver was distinctly palpable below the costal margin. Jaundice was not present, nor was there any apparent nasal condition to account for the epistaxis. Peripheral blood films were examined, but with negative results as regards the presence of malarial or other parasites. The films, however, showed evidence of a certain amount of blood changes of a destructive type.

A tentative diagnosis of Kala-azar was made, and in order to confirm it a liver puncture was carried out with the usual aseptic precautions. Examination of the smear preparation showed that no Leishman-Donovan bodies were present. These smears, how-

ever, contained "bodies" of a peculiar type, a description of which will be given later. The fæces were next examined; they were semi-solid, somewhat pale in colour, and showed no evidence of an intestinal parasitic infection.

Three days later a blood count was carried out. The red blood cells numbered 4 million, and the white cells 4,681 per c.mm. There was apparently a slight leucopenia. The hæmoglobin percentage was estimated at 70.

Peripheral blood films were carefully made according to the method recommended by Donovan [1]. These were stained and examined for the presence of protozoal parasites, but with negative results.

The erythrocytes showed a slight degree of poikilocytosis, and microcytes and megalocytes were in evidence. Nucleated red cells were not found. A differential count of 500 leucocytes showed the following percentages :—

	Per cent
Polymorphonuclear leucocytes	17·8
Large mononuclears	18·0
Large lymphocytes	44·6
Small „	18·8
Myelocytes	0·2
Mast cells	0·4
Eosinophiles	0·2

The above count showed that there was a great increase of the large lymphocytes and large mononuclear leucocytes at the expense of the polymorphonuclears. The results of the blood examination, together with the clinical evidence, were certainly suggestive of an infection with some protozoal parasite. To decide the question finally, it was considered advisable to carry out another liver puncture, and also a spleen puncture. It might be mentioned that, in puncturing the latter organ, its marked hardness was a noticeable feature, and the material obtained by this operation was extremely granular in nature. This granular material was constantly present in all the splenic punctures performed on this case. Microscopically, the spleen smears showed a few splenic cells and macrophages and a large amount of granular débris formed of broken-down red cells and fibrous tissue cells very similar to what is found in a disintegrating blood clot. Culture tubes containing Nicolle's media were inoculated with the spleen and liver material, and a healthy *Cercopithecus sebæus* monkey was inoculated intraperitoneally with a citrated emulsion of the liver material. A careful search was made through the smear preparations obtained from the liver and spleen, but no Leishman-Donovan bodies could be found. Nor could they be found in the culture tubes of

Nicolle's media incubated at 24° C., and examined from time to time.

As the writer was still of opinion that the case was clinically one of Kala-azar, a further series of spleen and liver punctures were made on March 11 and 25, and again on April 15, but with negative results. Agglutination tests were then carried out with the patient's serum against *M. melitensis*, *B. typhosus*, and *B. paratyphosus*, but with negative results; no organism was isolated from the blood or urine.

It will be convenient at this stage to leave the further clinical history of the case and describe the peculiar "bodies" found in the liver smears. A few of these "bodies" were also found in the spleen smears taken from the last two splenic punctures that were made.

In Leishman stained preparations of the liver smears there were seen numerous cell inclusions consisting of collections of "coccal bodies" of varying shades of blue and red enclosed within cells. (*Vide* Plate I.) The term "coccal bodies" is used somewhat arbitrarily; it describes, to a certain extent, the appearance of these cell inclusions. They resemble to all intents and purposes large cocci. The majority of them were enclosed in cells and massed together. Single and diplococcal forms, both inside and outside cells, were also found. Some of these "coccal bodies" showed distinct chromatin colouring, while others displayed a delicate rose pink. The majority, however, showed varying shades from a light blue to a deep purple. They were more or less uniform in size. The tinctorial effect was somewhat striking when a cell was found containing these bodies of different shades in colour. The free form showed a thin rim of a reddish tinge. The cells enclosing the "bodies" had, as a rule, a pale blue cytoplasm, which was often vacuolated.

In the spleen smears identical bodies were found, but they did not display the same variety of staining as obtained in liver smears. Large splenic macrophages with phagocyted red cells were also seen in the spleen preparations. As already stated, although no Leishman-Donovan bodies were found in the Nicolle's culture media, these "coccal bodies" were present in cultures ten days old. They were mostly free and appeared in Leishman stained specimens as purple staining bodies, each with a thin reddish-coloured rim. No developmental changes could be found occurring in them.

For the sake of convenience it will be advisable to consider further on in this paper the other characters of these bodies. Their

exact nature and possible significance will be found commented upon under the heading of "Remarks."

The further clinical history of the case may now be followed. As will be seen, I was still at a loss for a diagnosis, in spite of the fact that four liver punctures and three splenic punctures had been carried out. Donovan's [2] method of obtaining parasites from bone marrow by rib puncture might have been employed, but was not considered justifiable. It was not till three months had elapsed that the result of the animal inoculation confirmed the tentative diagnosis that the patient was suffering from Kala-azar. From March 25 till the end of April the patient's condition steadily became worse. The spleen continued to enlarge and reached to a point nearly two inches below the umbilicus. Some œdema of the feet and ankles was observed, and bronchitic râles were present in both lungs. The fever at this stage was of a remittent type, the evening temperature running up two degrees more than the morning one. The bowels moved twice daily and the stools were somewhat loose in consistence, but never of a dysenteric type. About three weeks later a change for the better occurred, the first sign of improvement being a cessation of the epistaxis; from this onwards the patient slowly but steadily continued to improve. The spleen began to diminish in size and the patient commenced to put on weight.

Owing to an enforced absence from Khartoum the writer had not an opportunity of seeing the case again till the early part of July. A considerable change was apparent as the patient was now able to walk about the wards. His temperature after July 12 was normal. The spleen, however, was still enlarged to a point an inch below the costal margin.

The improvement continued, and a month later the patient was doing light work and was apparently quite well. On August 19 the spleen had completely retracted under the costal margin and could not be felt.

Several peripheral blood films were taken at varying stages of his illness, but no parasites were ever found. A differential count of 500 leucocytes was carried out on August 6 with the following results:—

	Per cent
Polymorphonuclears	38·6
Large mononuclears	18·0
Transitionals	3·0
Large lymphocytes	20·0
Small lymphocytes	11·2
Eosinophiles	8·6
Basophiles	0·6

A very slight degree of poikilocytosis was present. Neither myelocytes nor nucleated red cells were found

If this count be compared with the differential count carried out in March it will be seen that the chief difference is shown in the increase of polymorphonuclear leucocytes, a diminution of the large lymphocytes, and a distinct increase in eosinophiles.

No specific treatment was adopted. The patient was given a nutritious diet in which native " butter-milk " figured considerably, so much so that the Egyptian officer of the prison attributed the patient's recovery to the " unlimited libation of this beverage."

Animal Inoculation.—The healthy *Cercopithecus sebæus* monkey which received an intraperitoneal inoculation of citrated liver material was examined from time to time. Apart from a slight rise in temperature it showed no ill effects till the eleventh week after inoculation, when there was some splenic enlargement noted. Smear preparations from two previous liver punctures made in the third and fifth week failed to show evidence of anything pathological. A careful search for the presence of the " coccal bodies " similar to those found in the patient was attended with negative results.

The monkey's liver was punctured again on June 9, i.e., about twelve weeks after the intraperitoneal inoculation. Several smear preparations were examined and typical Leishman-Donovan bodies were found. The result of this experiment confirmed the tentative diagnosis of Kala-azar. Owing to the writer's absence from Khartoum the monkey was not seen again till the middle of July. Apart from a slight degree of emaciation it did not appear to be much the worse. The spleen had increased in size and was readily palpable.

A fortnight later the animal died, and it was unfortunate that, owing to carelessness on the part of the native laboratory attendant, its death was not reported for a period of forty-eight hours. A post-mortem was carried out. The liver and spleen showed enlargement, particularly the latter organ, but, unfortunately, the post-mortem changes had advanced to such an extent that an examination for parasites was rendered hopeless even in the bone marrow.

Remarks.—There are many points of interest in this case that present themselves for discussion.

The result of the single animal inoculation more or less conclusively proved that the patient's disease was Kala-azar of an unusual type. No less than four liver punctures and three spleen

punctures were carried out, and examination of all the smear preparations made from these organs was attended with negative results as regards the finding of Leishman-Donovan bodies. The writer's experience in connexion with Kala-azar enables him to speak with confidence as regards this point, and a similar fairly extensive experience in spleen and liver punctures precludes any possibility of faulty technique regarding these operations. Many of the smear preparations of these organs have been examined a second time, so as to exclude the possibility of having passed over unexamined areas of the film, but in every case the second examination confirmed the results of the previous one.

It is difficult to assign any definite cause for the absence of Leishman-Donovan bodies in these smears; one might bring forward many speculative theories, but it is beyond the scope of this paper to do so. Possibly there may be some relation between this case and the infective splenomegaly that has recently been found by Gabbi [3] in Southern Italy. Gabbi has noted that the symptomatology of this infective splenomegaly is identical with Kala-azar, and considers that the condition is caused by an ultra-microscopic virus. One must therefore assume that this observer failed to find evidence of Leishmania parasites in these cases.

As Gabbi's original paper could not be consulted it is not known whether animal inoculation was resorted to as a means of aiding the diagnosis.

The nature and possible significance of the "coccal bodies" found in the liver and spleen preparations will now be considered again. The possibility of these being artefacts can be dismissed at once. Every care was used in carrying out the technique of liver and spleen punctures and in spreading the films on clean slides. For the operation of puncturing these organs the writer always used a small glass syringe sterilized by dry heat. In no case was citrate solution sucked into the syringe prior to puncturing the organ. By thus avoiding the use of a solution which inhibits the coagulability of the blood, the tendency to hæmorrhage is lessened and the danger of splenic puncture considerably minimized. Leishman's method of staining the films was employed, and to anyone cognizant of the results obtained by this method it was quite apparent that these "coccal bodies" did not represent stain deposits.

To prove that the "coccal bodies" were not the products of either cytoplastic or nuclear degeneration would be somewhat difficult. For it must be admitted that in the liver preparations some of the nuclei of the cells showed granular changes (*vide* Plate I,

fig. 5), and it was therefore quite possible that these bodies derived their origin from nuclear changes. Even if this be so, their existence in Kala-azar is still a point of interest, for, as will be mentioned later on, similar "coccal bodies" have been reported in the lesions of dermal Leishmaniasis, and it is not unnatural to infer that they are in some way closely associated with Leishmania.

I might mention here that twelve months ago I noted these "bodies" in two smear preparations from a liver puncture sent to these laboratories from an out-station in the Blue Nile province. Examination showed that Leishman-Donovan bodies were present, and one of the preparations showed a few cells containing "coccal bodies" identical with those described in the present case. As it was not possible to eliminate faulty technique in taking the specimens, no special importance was attached to them, nor were they met with again till the present case.

The use of special reagents showed that these "coccal bodies" were neither fatty nor glycogenic in character. As already mentioned, their morphological characters gave one the impression that they were coccal organisms of a specially large type. They were, in the main, Gram-positive, but some showed a certain amount of indifference to retaining the stain. If they were micro-organisms, and of the nature of cocci, one would have expected a certain amount of inflammatory reaction in such organs as the liver and spleen; but there was certainly no indication of this in the peripheral blood, judging from the differential leucocyte count. Leaving aside the doubtful question of their origin one might now refer to papers by different observers who have noted the presence of these "coccal bodies" in other Leishmania infections. Carter [4], in a paper on the cultural characters of non-ulcerating oriental sore, refers to them as follows:—

"A curious feature in cultures of non-ulcerating oriental sore, first noted by me [5] in October, 1909, is the constant occurrence of enormous clusters of what seem at first sight to be giant cocci. These bodies stain purple and have a reddish margin or film around them. They vary from forms the size of an erythrocyte to smaller forms altogether like cocci, diplococci," &c.

Thomson and Balfour [6] also noted the presence of giant "coccal bodies" in smear preparations taken from two cases of non-ulcerating oriental sore. In these two cases the skin epithelium was intact, so there was but little possibility of these bodies representing skin or other contaminations. Seidelin [7], too, in a very recent paper, mentions the presence of a coccus in four cases of

dermal Leishmaniasis observed in Yucatan. Seidelin considered that the coccus was primarily associated with the Leishmania, in which case he stated it would be of pathogenic importance.

Whatever be their nature or origin there is a certain amount of evidence to show that these "coccal bodies" are associated in some way or other with certain Leishmanial infections.

Recently Leishman [8] and Low [9] have called attention to the presence of peculiar cell inclusions met with in the blood of cases of blackwater fever. Further investigation is required to prove the rôle played by these cell inclusions in that disease, and for the same reason it is the writer's opinion that the "coccal bodies" described in this paper deserve a certain amount of attention by workers interested in the subject of Leishmaniasis.

Other points of interest in the case recorded in this paper merit some reference.

In the first differential leucocyte count carried out attention was called to the great increase of large lymphocytes. In the writer's experience this is a very constant feature of Kala-azar in the Sudan, more especially when the disease is well advanced. Rogers [10], in his classic work on "Fevers in the Tropics," refers to the increase of lymphocytes and mononuclear leucocytes that is present in Kala-azar, malarial cachexia, and in typhoid. He does not, however, state what type of lymphocyte is increased. Most hæmatologists differentiate two types of lymphocytes, the small and the large. The latter is much the larger, and may even have a diameter of 20 μ. Its cytoplasm is relatively more abundant than in the case of the small lymphocyte, and it is easily differentiated from the large mononuclear cell by the intensity of its nuclear strain.

In Kala-azar met with in the Sudan it is the large lymphocyte that shows such a marked numerical increase, and in the writer's experience this has been of considerable value in a differential diagnosis. It is interesting to note, too, that Thomson and Balfour [6] found a great increase of these large lymphocytes (up to 40 per cent) in a differential leucocyte count in blood taken from the lesions of non-ulcerating oriental sore, while the differential leucocyte count of the peripheral blood in the same cases showed only 8 per cent large lymphocytes.

If the tables of the two differential counts carried out at the height of the patient's illness and during his convalescence are compared, it is evident that the latter count shows an increase of polymorphonuclear leucocytes and eosinophiles.

It was difficult to account for this eosinophilia. In the Sudan it is generally associated with the presence of metazoan parasites. Low [11], however, in a recent paper states that an absence of an eosinophilia does not necessarily exclude a parasitic infection. To eliminate any possibility of an intestinal parasitic infection, the patient's fæces and urine were carefully searched for parasites but with negative results. The existence of filariasis or any parasitic skin condition could also be excluded. Was this eosinophilia connected in any way with the disease from which the patient was recovering?

There may be some close link between the two; for Marshall [12], in the pathological report of the Sudan Kala-azar Commission, mentions the occurrence of an eosinophilia in two recovered cases of Kala-azar.

The writer [13] also found in a case of parasitic granuloma a very marked eosinophilia present in the local lesions when the latter were healing. With such meagre evidence it would be rash to draw any conclusions; still, from a therapeutic point of view, the production of an artificial eosinophilia might be worthy of a trial in the treatment of a disease where medicinal measures have so far proved more or less of a failure.

The main points in this paper may be briefly summarized :—

(1) The absence of Leishman-Donovan bodies in the spleen, liver, and peripheral blood of a case presenting many of the clinical signs and symptoms of Kala-azar.

(2) The presence of "coccal bodies" in the liver and spleen of such a case, and their existence in other forms of Leishmania.

(3) The value of animal inoculation in the diagnosis of such a case.

(4) The constant presence of an increased number of large lymphocytes in the peripheral blood of cases of Kala-azar in the Sudan.

(5) The development of an eosinophilia in recovered cases of Kala-azar and its possible therapeutic value.

(6) The apparent recovery of the patient without any specific line of treatment.

My thanks are due to Dr. Crispin and Dr. Atkey of the Sudan Medical Department for kindly placing the case at my disposal, and to Dr. Mashouff for his courteous assistance in the clinical work. I am also indebted to Mr. George Buchanan for the coloured plates.

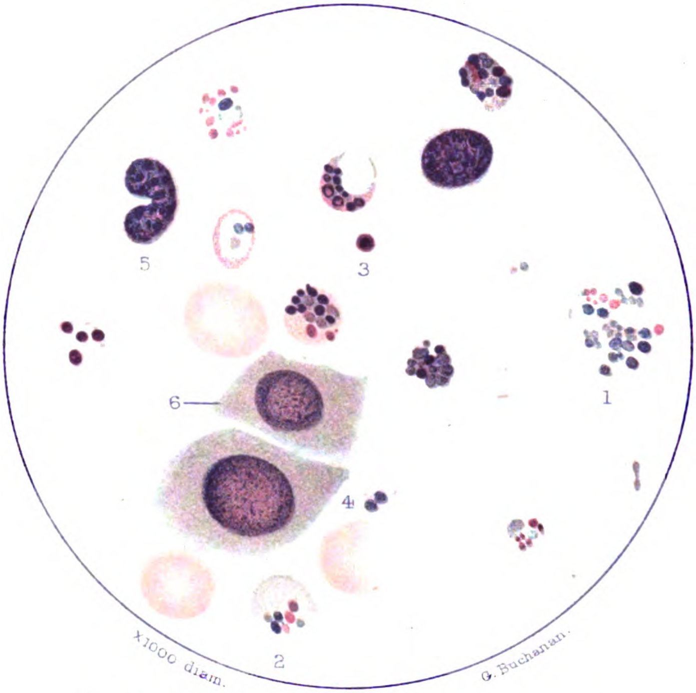

Fig. 1.—Liver smear from patient. **Leishman stain.**

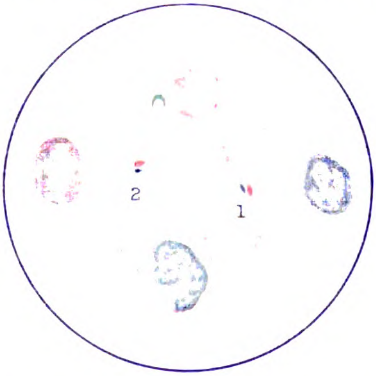

Fig. 2.—Liver smear from inoculated monkey. × 1,000 diam.

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DESCRIPTION OF PLATE.

Fig. 1.—Liver smear from patient. Leishman stain.

1. Showing "coccal bodies" in a vacuolated cell.
2. Showing "coccal bodies" of different shades of colour.
3. Free "coccal body."
4. Diplococcal form.
5. Cell with nuclear degeneration.
6. Liver cells.

Fig. 2.—Liver smear from inoculated monkey. × 1,000 diam.

CONCERNING MEDICAL AFFAIRS DURING THE CARNATIC, MYSORE, AND TRAVANCORE CAMPAIGNS OF 1760 TO 1818.

By Colonel R. H. FIRTH.

During the last three years I have devoted many spare hours to examining old records available in various offices in Madras, Calcutta, and Simla, in order to trace the career of my paternal grandfather, whom family tradition had credited with a not ignoble career in H.M. 12th Foot during the early years of the last century. The opportunity of reading old dispatches and documents has been unique, and in the course of these purely family investigations one has come across certain references to old time military medical matters which seem to be worthy of publication. They are interesting as throwing some side-light on the conditions under which our predecessors served, and also of importance as bringing to light the names of forgotten medical officers who, in their day, seem to have displayed the same gallantry and devotion to duty as men of our own time. Circumstances, however, were not favourable to publicity in their day, which was not the period of Victoria Crosses and substantive promotions; the result has been that the existence of these men and their actions were known to but few and their names are long since forgotten. If it be but to resuscitate the memories and names of these men, it seems to me the following disjointed notes deserve a place in our Journal. One does so with all the more interest in that, in the same dispatch reporting my grandfather as having been wounded, reference is made to the wounding of a medical officer of an associated battalion.

The *locale* of my original research was Madras, but the many interesting finds made have induced me to dip into other record chests for evidence bearing on our earlier military operations in that Presidency. The quest among old documents has been fascinating. It is true many of them are of little historical value, still the old Madras General Orders are both quaint and interesting. The series available are incomplete, but a perusal of them gives one a very good idea of what life in the old coast army must have been like. They mark the rise in discipline from the time (1760) when sentinels were warned to salute and not to take off their hats and bow, to the time that General Bowser (1821), in taking leave of the army, addresses it as " an Army that has shared the glories of a

Coote and seen the rise of Wellington," and "worthy of comparison with any Army."

In these old Orders the methods of dealing with military offences is clearly traceable from the beginning, when deserters are recorded as casting dice on a drumhead to settle which of them should die as an example to others; we read of men blown from guns, flogged, and having their ears cut off for the same offence of desertion.[1] Flogging in those times meant the infliction of as many as a thousand lashes. A very common punishment to be found published in General Orders, even as late as 1821, was 750 lashes, and this too for even lesser offences than desertion. Gradually the tone changes and we find mutilations dropped, then dicing for death is not referred to, later the punishment by blowing from guns is replaced by sentences of transportation to penal colonies. Last of all we find that flogging is less frequent and gives place to solitary confinement. That these drastic punishments were necessary appears to have been due to the stamp of men who were in the old days impressed for service in the East, for life, and without hope of return to their native land or any betterment of their lot. That the European soldiers in the Old Company's service were often the dregs of the home criminal population seems only too probable, as we find cases of men petitioning for consideration on the plea that they had not been convicted of a felony before being sent to India. Yet these are the men who won the Indian Empire. That their lives were hard and miserable, and they themselves held under an iron discipline, is only too well borne out by the number of cases recorded in these old papers of men discharging their firelocks through their wrists and feet to injure themselves permanently in the hope of obtaining their discharge. It is a terrible yet fascinating word picture recorded in these old General Orders, but through them all one finds the British officers imbued with an evident desire to help their men and better their lot where possible, also evincing the greatest solicitude for their comfort, and even for the care of their health as understood in those days.

Humorous glimpses of the social life of the times appear

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[1] For mutual protection in a more or less hostile country men did not desert singly, but usually in batches of three to five. After arrest and trial, all were not condemned to death; usually only one would be so sentenced as an example to others. The individual was not named, but the choice left to the men to settle among themselves. The curious thing to note is that this practice, of drawing lots as to which should suffer the extreme penalty, was officially recognized.

R. H. F.

occasionally among details of a sterner nature, as represented by not infrequent invitations to dinner being put into station and brigade orders. The orders issued after engagements or actions are often masterpieces of inspiring English, and full of very quaint words or expressions. Certain official regulations of the period are the apparent germs of the present Indian Army Regulations; they are equally quaint and often go into curious details. For instance, one dated 1763, and having reference to the interior economy of Fort St. George, directs that straying hogs are to be taken before the nearest justice of the peace for disposal. Another set of regulations directs surgeons to keep their patients clean, and allow each patient "about 6 feet of space" in hospital. Also, when reporting on epidemics, surgeons were not to give opinions taken from books, but to give advice derived from experience.

Of course, there is much in these old papers bearing on purely military matters. In these respects some of the minutes by various Commanders-in-Chief are interesting as they deal with subjects still often discussed, but giving quite old world ideas and views. As an example, one may refer to a particular memorandum dealing with the formation of Rocket Troops, in which it is laid down that "we may confidently expect that in time the Rocket will supersede light field guns." The same papers are also often concerned with discussions as to the organization of the means for carriage of the sick and wounded in the field, and the supply of British officers to Native Corps. Some of the paragraphs on these topics written in 1772 might well have been written in 1912. Apart from these technical questions, the old papers teem with reports and decisions concerning quarrels and bickerings among officers as to matters of precedence, authority, and share of booty or prize money. In all these there is much to suggest the effects of a long residence in a tropical climate combined with an indiscreet dietetic regimen, and not a little which reminds one of quarrels or squabbles which still arise in India, but happily in a milder form, and only towards the and of the hot weather.

One could enlarge much further on the fund of interesting things hidden away in these old papers, but space will not allow of it. The main object of this article is to refer to medical affairs and medical officers. On these matters the material is unsatisfying, as so many nominal rolls of Corps give the names of all officers except those of the medical officers. One has pored through pages of many Army Lists from 1781 to 1825, but the earlier ones being all in manuscript the legibility of names is not always easy.

On January 22, 1760, Colonel Eyre Coote defeated the French under Lally at Wandiwash. The victory was decisive. The want of medical organization and hospital comforts was apparently much felt, as Coote, in a letter dated January 25, says: "Really the scene is now dreadful to see. Such a multitude of poor objects, and not in my power to give them the least assistance for want of every one necessary requisite for an hospital. I make no doubt upon this representation you will do everything humanity can direct. If it is possible to send surgeons and proper people from Madras to attend the wounded here, who are very numerous, you may by that means save the lives of many gallant men, several of whom have not been dressed since the day of action. Assistant Surgeon Jennings is dead and Regimental Mate Richard Black too ill for work. As I shall be obliged to carry away three surgeons out of the other five, numbers must lose their lives."

Whether or not as the direct outcome of Coote's pathetic appeal, we find action taken for the formation of a medical service by the following extract from the Proceedings of Government, dated Fort St. George, Madras, December 1, 1760: "In consequence of a Minute of Consultation 7th of last month for remedying the irregularities which have been introduced in the management of camp hospitals, the following regulations are now made and ordered to be observed for the establishment thereof. That after this the rate of 2 pagodas a month be deducted from the pay of patient, and the Company to defray all the surplus charge. The sick to be provided with such diet as the Surgeons shall think necessary for their case. If the victualling can be performed by contract on the same terms as in the garrison, it will be most agreeable in all respects."

"Resolved that Mr. Briggs be Surgeon-General to the Army, and that he be allowed 10s. a day for that duty, which is to be as follows: He is not to be embarrassed with the charge of any particular Corps, but to superintend the whole, as well the General Hospital as the sick in the field. In the first place he is to take an exact account of all hospital stores, clothing, and medicines belonging to the Company now remaining, and to indent from time to time to Madras for what further want may be wanted, that so no stores, clothes, or medicines may be purchased in camp, and whenever he may have occasion to indent for new supplies he must at the same time send in an 'account remains.'"

"The Surgeon-General is to have under his charge and direction all stores and medicines, and to issue them as occasion require, and to take care that such servants as are really necessary for the duty of the hospital be employed at the Company's charge, and no more. All the other surgeons to report to him the state of the sick and other occurrences in their several departments, and he only is to make general reports to the Governor and Commander-in-Chief. He is to cause regular accounts to be kept in the hospitals, expressing the name of the patient, his disorder, the corps to which he belongs, the day received, and the day he died or is discharged, that so the contractor (supposing the hospital be victualled by contract) may be duly paid conformably thereto at the end of the month. He is also to cause a particular account to be drawn out at the end of every month for each of His Majesty's Regiments, debiting the same for the charge incurred for victualling the patients and crediting for the sums received by deductions as above from the men's pay, which account must be certified in the following manner" (then follows a schedule of account, not reproduced).

"A like account is to be drawn out monthly for the men of the Company's Corps, signed only by the Surgeon-General, and the paymaster at the camp is to pay the several balances to the contractor upon his producing the said accounts regularly signed and certified as above and not otherwise. The Surgeon-General is to cause like accounts to be drawn out for the several regiments for the time since the taking of Waldour in as exact a manner as possible, in order that the same may be certified by the Commandant of each Corps. If it should at any time happen that the victualling of the hospital should not be contracted for, the Surgeon-General is then to cause the patients to be victualled at the Company's charge, and the several accounts above mentioned are in that case to be debited for the real charge whatever that may happen to be. The Surgeon-General is allowed a writer to keep the above accounts."

"Agreed that Mr. Briggs have the allowance of ten shillings a day from the time he was appointed to act as Surgeon-General, and that instructions be now prepared for him agreeable to the foregoing plan. Ordered that a copy of the above regulations be sent to Colonel Coote, and that he be desired to give the necessary orders that they may be complied with. As a great charge will be incurred besides that of victualling the hospital, and which on behalf of the Company we do take upon us to bear, it appears but reasonable that

the medicines which His Majesty sends out yearly for his regiments be delivered to the Surgeon-General for the general service, and it is agreed to request of Colonel Coote to give the orders accordingly." (Signed), George Pigot.

One finds nothing referring to medical officers until the following quaint letter written by Government in August, 1761, to Major Alesieu, then commanding at Wandiwash. There appears to have been some ill-treatment of sepoys, against which a paymaster named Brooke and a hospital mate named Hunterman protested. Major Alesieu threatened to flog the latter for interfering. The letter runs as follows: "It is with pain we comply with the necessity you subject us to of taking notice of some parts of your conduct towards Mr. Brooke and Mr. Hunterman. You have been acquainted that Mr. Brooke is appointed by us to be paymaster of the garrison of Wandiwash, and our orders and instructions have been communicated to you; it is impossible, therefore, but that you must know it is a part of his duty to take cognizance of casualties in the garrison as well respecting sepoys as military, and the least reflection would clearly have suggested to you our motives for establishing such a regulation; notwithstanding which you refuse to submit to it, and that in such threatening terms as really astonish us. 'You will, by your authority as Commandant, flog any Conicopoly [1] that shall offer to take any account of casualties.' We really do not know from whence you derive your authority to flog any person, much less the hospital mate and servant of our paymaster in the execution of his duty." It is curious to note the social grading accredited to the hospital mate in these times.

In a dispatch from Major Campbell reporting his failure to capture Madura, dated June 26, 1764, there is reference to the wounding of a medical officer. "It is with the utmost concern I am obliged to acquaint you that we have this day met with a repulse in the attack of Madura." . . . "They, however, got up in several places to the top of the towers, but the enemy had under cover so many men with long pikes which they kept pushing across one another and throwing large stones, hand grenades and shells down the breach, that our soldiers found it impossible, notwithstanding the spirited example of all the officers, to gain the top of the breaches, and therefore retreated. Our loss in this unfortunate affair is Captain Bullock and Ensign Vashon killed, Major Preston, Captains

[1] The term Conicopoly was meant in those times to mean any servant or minor official.—R. H. F.

Kirkpatrick and Fitzgerald, Lieutenants Ware and Owen, and Ensigns Macdonald and Bruce wounded. Surgeon Fisher was wounded also by a large stone while succouring Major Preston on the right attack. I guess about 120 Europeans killed and wounded, besides many others who have bruises from stones, but I have not yet been able to get an exact return of them or sepoys, though I suppose there are of the latter about fifty killed and wounded." . . . One has been unable to trace further reference to this Surgeon Fisher, but the Major Preston died of his wounds shortly afterwards.

The pay of a Surgeon at this time in the Company's service appears to have been 131 pagodas a month with a tentage allowance of 3 pagodas. The Assistant Surgeons were paid 57 pagodas a month with the same tentage allowance. Both grades of pay included horse allowance, which was put at 36 pagodas a month for the Surgeon and 12 pagodas for the Assistant Surgeon. In the majority of the Company's regiments the hospital supplies were contracted for by the Surgeon, who by this means added materially to his emoluments. The pagoda was equal to 3½ Company rupees, and 42 fanams went to the pagoda and 80 cash to the fanam.

The sickness prevalent in these times, judging from an inspection of a few parade states available, was 14 per cent among Europeans and 11 per cent among the sepoys. As regards casualties in action, it is difficult to find accurate records, but the following abstract from an account of the killed and wounded in the different corps before Pondicherry between October 2 and October 18, 1778, shows that out of a strength of 4,311 there were of all ranks 68 killed and 190 wounded.

As illustrative of those strenuous times we have the following occurrence recorded. On September 5, 1780, a force of some 3,500 men were heavily engaged at Conjeveram with some 30,000 men of Tippu's army under Hyder Ali. The British force was under Colonel Baillie; it held its own for two days, but owing to the explosion of two ammunition carts one front of the square was disorganized, and the enemy broke through, with the result that practically the whole force was cut up. Of 86 officers present, 38 were killed, 32 wounded, and only 16 escaped. Among those killed was Surgeon Wilson, of H.M. 73rd Foot. On the following day, Colonel Baillie, who was wounded, was carried before Hyder Ali. He was received with abuse and entertained by having the heads of all the killed officers formally presented to him. The first head brought was that of Surgeon Wilson, of Baillie's own regiment; then followed

those of Captain Phillips and Colonel Fletcher. The above details are taken from a letter from Colonel Baillie reporting his experiences.

The next incident containing any medical reference is in respect of the revolt of four companies of the Circar battalion at Vizagapatam on October 3, 1781. The occasion was their embarkation for Madras, when just as the men were going on board ship they suddenly fired on all officers and upon every other European within sight. Lieutenant Crisp, Cadet Venner, and Mr. Rutherford the paymaster were killed on the spot. Captain Lane, Surgeon Gordon, and many others were wounded. Lieutenant Brown, Mr. Doveton, and Assistant Surgeon McMahon escaped.

The following extract from a report by Lieutenant Champneys to Colonel Lang, after the repulse of an attack on the fort at Vellore, November 4, 1781, shows that even in those days medical service was not without its risks. "At nine o'clock we beat to arms. A little later the attack began on our right breach. . . . At three o'clock they came on again with loud cries, but the severe platoons from the right and left sections of the rampart checked them. . . . A shot or two entering the bastion at this time cleared it and wounded several, including Captain Boyd and Assistant Surgeon Corbet, who was succouring the wounded. I then got a volunteer party with promises of reward to clear the lodgement of the enemy, which was immediately performed by Serjeants Lantwein and Johnston."

In February, 1782, a Colonel Brathwaite with some 1,700 men was surprised by Tippu, and after twenty-six hours' fighting the whole force was routed. Among the killed was Surgeon White and Ensigns Graham, Thewles, and Loy, all of the Cavalry.

The next item of interest to ourselves is the following order issued on October 14, 1784, from Fort St. George, for the regular organization of a medical department for the Company's army: "That the establishment of Surgeons shall in future consist of 1 Surgeon-General, 2 Surgeons-Major, and 27 other full Surgeons, comprehending in the whole 30 Surgeons, who are to be and to rank as follows, and in future there is to be no appointment made of a full Surgeon, but upon an actual vacancy in the number hereby established." Then comes a list of 29 Surgeons and 17 Assistant Surgeons who were posted as follows:—

Madras	Surgeon-General John Briggs.
	Surgeon-Major William Duffin.
	Surgeon Alexander Farrier.
	Surgeon J. Anderson.

		Assistant Surgeon John Laird.
		Assistant Surgeon George Bell.
The Mount	...	Surgeon James Richardson.
		Assistant Surgeon George Lepper.
Arcot ...	...	Surgeon-Major Colly Lucas.
		Surgeon Nicol Mein.
		Surgeon T. Gahagan.
		Assistant Surgeon Vincent Orme.
		Assistant Surgeon Robert Trotter.
Vellore ...	...	Surgeon George Anderson.
		Surgeon Patrick Bowie.
		Assistant Surgeon (name not legible).
Tanjore ...	...	Surgeon William Ruddiman.
		Surgeon George Oglevy.
		Assistant Surgeon Egmore.
Trichinopoly	...	Surgeon F. Ferguson.
		Surgeon George Binnie.
		Assistant Surgeon R. Murray.
Ellore ...	...	Surgeon John Kincaid.
		Surgeon (name not legible).
		Assistant Surgeon R. Wilson.
Masulipatam	...	Surgeon Henry Miller.
		Surgeon (name not legible).
		Assistant Surgeon Cuddamore.
Vizagapatam	...	Surgeon Alexander Anderson.
		Surgeon Rollo.
		Assistant Surgeon Sevenwright.
Ganjam ...	...	Surgeon E. Steward.
		Surgeon Davies.
		Assistant Surgeon (name not legible).
Madapollam	...	Surgeon J. Bulman.
Nagore ...	...	Surgeon M. Thompson.
Warioor ...	...	Surgeon James Richardson.
		Surgeon Raine.
		Assistant Surgeon Henry Harris.
Machura...	...	Surgeon T. Lord.
Palamcottah	...	Surgeon J. Leslie.
Sautghur...	...	Assistant Surgeon Thomas Brae.
Permacoil	...	Assistant Surgeon (name not legible).
Chingleput	...	Surgeon J. Adderton.
Nellore ...	...	Assistant Surgeon (name not legible).
Ongole ...	...	Assistant Surgeon Charles Oglevie.

In April, 1786, the establishment seems to have been revised in conformity with orders from England to be, a Physician-General as Director of Hospitals with a salary of £2,500 per annum; a Chief Surgeon at £2,000; while the Head Surgeon of the Hospital where 8,000 men were stationed, was to have £1,500, and the Surgeons of all other General Hospitals £1,000 per annum. Regimental Surgeons were to receive the pay and allowances of Captains, Assistant Surgeons or Hospital Mates those of Lieutenants, and Regimental Mates or Assistant Surgeons attached to Regiments those of Ensigns.

A Board composed of the Physician-General, the Chief Surgeon, and the Head Surgeon at the Presidency was entrusted with the administration of the medical department. The following system of promotion was introduced at the same time: "When a vacancy of Surgeon at the head of any of the Hospitals shall occur, the Hospital Board will recommend to the Governor and Council the most deserving Regimental Surgeon for the succession, the most deserving Hospital Mate to succeed the Regimental Surgeon, and the most deserving Regimental Mate to succeed the Hospital Mate; but although the most ample encouragement is hereby given to merit, yet it must be understood that seniority and equal merit are to have the fairest claim to promotion."

Soon after the Surgeons were divided into five classes, the first class to comprehend the Hospital Board; the second to include Head Surgeons to Hospitals; the third to comprehend First Surgeons to Hospitals; the fourth all Regimental Surgeons, and the fifth all the Mates to Regiments and Hospitals. In July, 1786, regulations were published for the guidance of medical officers in charge of hospitals, and in January, 1787, relative rank was assigned to medical officers as follows: The Physician-General as Brigadier-General, Chief Surgeon as Colonel, the Head Surgeon to a Hospital of a place with 8,000 men as Lieutenant-Colonel; all Head Surgeons to other Hospitals as Majors; the Surgeons to Regiments as Captains, and all Assistant Surgeons as Subalterns.

In 1793 we find the following Order of Council, dated Fort St. George May 16: "In consequence of recent affairs wherein certain officers holding two Commissions of Captain and Surgeon have used the power conveyed to them by virtue of the former to the prejudice of discipline in the hospitals, it is notified that all Surgeons or Mates in our various regiments of Cavalry or Infantry who may hold other Commissions must, before December 31 of this present year, elect as to which of their Commissions they will

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vacate." This curious order evidently had its origin in some case where a junior medical officer with a double commission had, by virtue of his combatant rank, overridden the commands of his seniors who had only the commission of a surgeon. I cannot trace any such incident, but it evidently was the suggestion, for a very similar War Office order of April, 1796, is quoted by Gore.[1] That writer says that some officer in India, who was captain and surgeon of his regiment, had led his corps out of action, and, as the only surviving senior officer, commanded it on its return to England. It is quite possible, and not improbable, that such was the case. I have made every endeavour to trace the actual case, but quite failed. For many reasons it is very desirable that it should be traced; but as each year goes on the chances of its being unearthed become less.

Nothing further is traceable till 1797, when orders concerning medical affairs were sent out from home directing the appointment of a new Board to be composed of two members, whose duty it should be to superintend the department and the conduct of all persons employed therein. The members were the Physician-General and Chief Surgeon. No names are mentioned nor traceable. It was ordered that all medical officers should be called upon to make their election between the civil and military branches of the Service. The Board of two was duly formed, but the separation of the medical department into two branches was disapproved of by the local Government and postponed pending reference to home. Confirmation was not given so the separation was not carried out. The establishment was fixed at this time at 104 Surgeons, of whom 60 were full Surgeons and 44 Assistant Surgeons. Of the former 2 were posted to the Artillery, 2 to the European Infantry, and 11 to the Native Infantry. Of the latter 4 were posted to the Cavalry, 2 to the Artillery, 4 to the European and 22 to the Native Infantry, that is to say one Assistant Surgeon to each battalion of the latter. One Assistant Surgeon was also attached to the Pioneer Corps and one to the Madras Special Native Battalion. This seems to be the first occasion on which the native units of the Army were given special and permanent European medical officers. The other medical officers on the establishment seem to have been posted to various garrison charges. No nominal roll of this time is available.

During the siege of Seringapatam in 1799, the following casualties are given in the records of H.M. 12th Foot. The regiment

[1] NOTE.—"Our Services under the Crown," by A. A. Gore, Surgeon-Major. London: Baillière, Tindall and Cox, 1879, p. 133.

had 17 men killed and 49 wounded, and Lieutenant Shawe was shot through the leg in the assault. The following officers died from extraordinary fatigue and the effects of climate; Major Allen, Captain Buckeridge, Lieutenants Percival and Grahan, also Assistant Surgeon Bacot.

Following the acquisition of the Carnatic in 1801, there was desultory fighting round Tinnevelly and Madura. Major Macaulay experienced a repulse on March 31 of that year at Panjalamcurchy, and out of a force of 2,800 men lost 51 killed and 267 wounded. Among the latter was Surgeon Barter of the 3rd Light Infantry. Again, on July 23, 1802, during operations against the Polygars we find Colonel Innes reporting a severe engagement in which out of a force of 380 men he lost 16 killed and 44 wounded. Among the latter were Captain Heitland of the Pioneers, Lieutenant Firth[1] of H.M. 12th Foot, and Assistant Surgeon Parminter of the 7th Native Battalion.

In 1803 appeared a long dispatch by General Wellesley dealing with certain matters connected with the death of Captain Brown of H.M. 78th Foot. This officer was killed on July 16, 1803, by Captain Duncan Grant of the same regiment, in a duel arising out of a dispute as to who had authority to order a piper to play at dinner. A court of inquiry gives the evidence of Surgeon Young of H.M. 78th Foot and of Assistant Surgeon Bean of H.M. 76th Foot. From this it would appear that Brown was shot in the abdomen, the bowel being perforated in three places. He died twelve hours later. It is interesting as being, from the details given, essentially a case which under modern surgical procedure might well have been saved. Captain Grant, curiously enough, was himself killed in a petty engagement about a month later.

The great battle of Assaye followed in the September of the same year. We had 5,680 men present, of which 4,520 were under fire, and of these no less than 1,584 were killed or wounded. Though there appear to have been no medical casualties, one learns from the Journal of Captain (afterwards Major-General Sir Jasper) Nicholls that great difficulties were experienced by the Surgeons in dealing with the large number of wounded, many of whom remained undressed for a week, owing to the paucity of medical officers and appliances. Wellesley took great personal

[1] NOTE.—William Firth, born 1776, Ensign H.M. 12th Foot, 1795, Lieutenant 1799, Captain 1805, Major 1814, retired 1819 after the regiment had returned to England, married 1820 and settled at Norbiton, Surrey. Died 1837.

interest in the care of the wounded after this battle sending wine and food for them from his private stores. He took an active part in the selection of the site and organization of the field hospital at Ajanta and submitted a strong dispatch to Bombay asking for medical relief. So serious was the situation from the number of wounded that the army could not move until October 6, or some ten days after the battle.

Coming to 1805, we find an interesting account of a treacherous attack by Pindarries on the camp of Mr. Jenkins, the Resident at the Court of Scindia. This was on January 25, and in his report on the incident Jenkins mentions specially the gallantry of Lieutenant Green of the 11th Infantry, and of Mr. Wise, the Residency Surgeon, both of whom were severely wounded.

On January 1, 1806, the Governor and Council issued an order that after that date no stoppages were to be made from the pay of soldiers for the supplying them with native dressers. These dressers were a part of the hospital staff and analogous to what we call ward servants in these days. It was now ordered that all native dressers were to be taken on the strength of Corps and paid by Government at the rate of 10 pagodas a month. One dresser was authorized for a Cavalry Regiment and two to each Infantry Battalion. Considering the value of the pagoda their pay was good, but it is probable that they had to supply certain country medicines and articles out of their pay.

In the following month, that is on February 27, 1806, there came out another very interesting order authorizing the formation of what may be described as the first bearer corps. The order actually uses the term "bearer corps," and was signed by G. Strachey, Secretary to Government, and promulgated to the Army by the Adjutant-General, Lieutenant-General Sir F. S. Cradock. It orders that men be specially enlisted for employment in the carriage of dhoolies for the conveyance of the sick and wounded, or as cauvedy coolies for the carriage of hospital stores. These bearers were to be formed into companies, each company consisting of 1 head maistry, 3 second maistries, and 90 men. The pay was fixed at 4 pagodas per mensem for the head maistries, 3 pagodas for the second maistries, and 1 pagoda 34 fanams for the men, besides batta at the rate of 1 fanam a day when marching or in the field on service. It may be stated that 42 fanams went to the pagoda which was practically 3½ Company rupees. The men were ordered to be enlisted in the same manner as sepoys, and to have the same privileges as regarded prize money, family certificates, and pensions. The

maistries were ordered to be armed with a dagger or short sword, and each of the bearers to be armed with a short spear. A European officer was appointed to command the corps, which was to consist of three companies, but there is no record to show that it was to be a medical officer. This old order which brought into being the first bearer corps as far back as February 27, 1806, seems to me to be unusually interesting and probably likely to be new to most readers.

The same year saw the authorization of the following scale of pay for the Surgeon of H.M.'s regiments, that is of the Royal Army, namely, 120 pagodas monthly, a staff allowance of 100 pagodas, and head money of 7 pagodas for each 100 men. This meant that with a battalion of 1,000 men the senior Surgeon drew the equivalent of about 1,105 rupees. The pay of Assistant Surgeons was at this time 72 pagodas with 30 pagodas staff allowance. Senior apothecaries drew 40 pagodas, assistant apothecaries 22 pagodas, apprentices 10 pagodas, compounders 3 pagodas, and dressers 2 pagodas 32 fanams. Stewards drew 35 pagodas, and their apprentices 8 pagodas. Excluding menial establishments, a regimental hospital pay bill was 250 pagodas monthly.

The next incident of medical interest is that of the mutiny of sepoys at Vellore on July 10, 1806. The cause of this was evidently a recent order promulgating the general use of a new turband which was very unpopular with the men, especially those of the 1st and 23rd Battalions of Native Infantry. As a result of this order these men suddenly mutinied on the night of the 10th, the only European troops present being six companies of H.M. 69th Foot. "The outbreak was so sudden and well organized that by dawn practically all the Europeans were killed and wounded. So critical was the situation that early on the morning of July 11 the men had scarcely a ball cartridge left. To attack the arsenal was deemed impracticable, and the only remaining chance of gaining ammunition was by attempting to gain possession of the grand magazine. The main body of the survivors, consisting of a detachment of H.M. 69th Regiment, proceeded under Captain Barrow to carry the bastion and cavalier at the south-east face of the Fort, which lay on our way to the flagstaff and magazine, then defended by a strong party of the insurgents. In advancing to the attack Captain Barrow fell by a musket shot passing through his leg. There then remained no officer except Surgeon Jones of the 1st Native Battalion and Assistant Surgeon Dean of the 23rd Native Battalion to carry the plan into execution, who, leading on the

party, carried the cavalier and bastion, but with the loss of many men." The above is a quotation from part of a long official report on this outbreak. The much reduced and hard pressed garrison of Vellore was relieved the next day by the arrival of cavalry under Colonel Gillespie from Arcot.

The officers and men engaged in the suppression of this mutiny were thanked for their services, and the Court of Governors also resolved that medals with a suitable inscription should be presented to all survivors of the garrison and to the relieving force. The resolution was never carried out. Had Surgeons Jones and Dean done such an exploit in these days we know they would probably not have gone unrewarded. One fails to trace any recognition of their service. Of Dean no further reference is available, while as to Jones, the most one can find is that he was Chief Surgeon at Waltair in 1809. The Europeans killed in this outbreak were 15 officers, 9 non-commissioned officers, and 91 privates, while 4 officers and 76 rank and file were wounded.

The records of the next two years are quite barren of matters of medical interest. In those for 1809, however, we find a dispatch by Colonel Picton describing a severe engagement at Quilon on January 15, in which we lost 18 killed and 123 wounded. Among the latter were Surgeon Robert Erskine of H.M. 12th Foot, very severely wounded, and Assistant Surgeon Davidson of the Company's Artillery.

In the following month Colonel Chalmers reports marching from Quilon to Trevandrum and occupying the city on March 2, 1809. The Dewan at once committed suicide, but his brother was taken and hanged for participation in the murder of Assistant Surgeon George Hume of the Company's service and of thirty-three men of H.M. 12th Foot, which had been treacherously perpetrated at Alleppy on December 29, 1808. The Travancoreans of this period appear to have been somewhat barbarous, as the details of the murders were unusual. Assistant Surgeon Hume was with a battalion of the Company's troops at Alleppy. Some hostility to their presence having arisen among the local inhabitants an attack was made. The only European who fell into their hands was Hume, who was practically stoned to death. The men of H.M. 12th Foot fell into their hands owing to being shipwrecked on the coast while coming from Cannanore to strengthen the garrison in Quilon. The party were seized, their wrists broken with an iron bar, and the whole confined in a house for four days. Scarcely able to walk, they were then conducted to a cliff and thrown into the

sea. Serjeant-Major Tilsey was reserved to the last, and after witnessing his companions hurled successively over the cliff, was himself sent to a similar fate. The details of this incident are graphically recorded in the deposition of a native cook boy who was with the shipwrecked party, who by hiding escaped, but saw the whole affair. It was only owing to this lad's evidence that information was available as to what had become of the shipwrecked party.

Among the records for 1808 we find a mass of correspondence as to the load carried by sepoys and the manner of its transport. It would seem that the men practically carried on the march a load of 80 lb., and that large numbers constantly fell out of the ranks in consequence. It was represented that the European soldier under similar circumstances was relieved from this embarrassment, as his kit was carried for him by coolies. The Commander-in-Chief of the time recommended the same practice for the native troops, but the Governor and Council refused to bear the increased charges for transport. Two years later, however, the concession of Government carriage of this kit was granted.

In 1809 one finds a voluminous and instructive literature relating to the so-called "white mutiny," or protest of the Company's officers against certain new regulations, whereby their position and prospects were endangered by preferences given to officers of the King's regiments. I have been through the whole of this, but can find no reference to medical officers being implicated in this movement. It probably did not affect them.

On October 10, 1810, new regulations were issued by the Governor and Council regarding the medical service of the Company's troops. The essential points were that the Administrative Board was raised to three members, namely the Physician-General on a monthly pay of 800 pagodas, a Chief Surgeon at 700 pagodas, and a Staff Surgeon on 600 pagodas. This term Staff Surgeon appears for the first time and replaced the former title of Head Surgeon. The salary of a Staff Surgeon, not a member of the Medical Board, was fixed at 450 pagodas per mensem. Although at this time the Company's establishment of medical officers seems to have been 62 full Surgeons and some 80 juniors, only 9 of the former were doing military duty. This state of affairs had attracted the attention of Government, who issued a scathing memorandum in which they considered this drifting of senior and experienced medical officers to zillah stations and the performance of civil duties was incompatible with the efficient medical charge of the Company's

soldiers. They accordingly ordered more juniors to be detailed for civil duties and assigned the following distribution of the seniors to the various native military cadres: to Horse Artillery 1 Surgeon and 1 Assistant Surgeon, to Cavalry 8 Surgeons and 8 Assistant Surgeons, to Foot Artillery 3 Surgeons and 3 Assistant Surgeons, to Infantry 25 Surgeons and 48 Assistant Surgeons. It is curious to find in 1810 the existence of a civil and military medical problem which is not unknown in 1912.

The records after this date refer mainly to the operations which led to the completion of the conquest of Java and adjacent islands in 1812 and the desultory fighting in the Deccan against the Pindarries and Mahrattas up to 1818. Among all this material one has been unable to find much referring to either medical officers or medical affairs. The only items worth recording are the constant references to the unhealthiness of the troops in Java, the Moluccas, and Samatra. One medical officer only is mentioned, namely, Assistant Surgeon Milne of the Madras European Regiment, who died at Banda in 1811, "after showing great fortitude in suffering and much devotion to his duty." What pathetic meaning may not be read in those twelve words.

The conquest of Java seems to have involved much sickness. Some 10,800 men left Madras for that expedition on April 18, 1811. No records show the names of medical officers with individual units; in fact the only reference to medical personnel is a statement that 2 Surgeons and 11 Assistant Surgeons were attached to the staff, and that of these Surgeon John Macandie was drowned while passing from H.M. ship "Dover" with a landing party in the attack on the Island of Samarang, and that Assistant Surgeon John Leyden died at Amboyna. Macandie was Surgeon to H.M. 78th Foot, and died February 15, 1812, while Leyden was on the Madras establishment of the Company. The only details available about him are that he was a poet of no mean merit, and had written a book of "estimable lyrics." It would be interesting to know if anyone has ever come across a copy of Leyden's poems. The only further reference to military medical affairs in Java is an Order of Council, dated February 10, 1912, directing Commissary-General Morison to dispatch on the brig "Venus and Caroline" "such medicines and medical provisions to Batavia as the Physician-General shall think necessary to amend the condition of the troops now operating in the Dutch Indies."

The records for the succeeding years to 1825 cover the Mahratta War, the operations in Ceylon, and the first Burmese War. They

are notably devoid of medical casualties. I can only find one, namely, the wounding of Surgeon Robert Dickson of the 16th Native Infantry at the action of Mahidpoor on December 21, 1817. The General Orders of these times contain the names and postings of many medical officers, but little of interest. Occasionally one finds, among the many courts martial on officers, one held on a medical officer. Thus, one dated January 21, 1821, promulgates a sentence of fourteen years' transportation for forgery upon a Surgeon of the 1st Battalion, 9th Native Infantry. Again, one dated September 28, 1825, sentences Assistant Surgeon Greenwell, of the 68th Native Infantry at Arracan, to be dismissed the service for neglect of duty and intoxication. A curious feature of these times is the number of officers court-martialled for drink. In respect of Greenwell's case the Commander-in-Chief, in confirming the finding and sentence, adds the following remarks: "His regret that he should be so frequently called upon to enforce the penalty awarded for intoxication against those whose education and rank in society aggravates the character of that degrading vice." The same orders are full of laudatory phrases of the work of many officers, but in them all, from the battle of Plassy to that of Bhurtpoor, I can find no reference to the good work done by the medical service. An exception occurs in that referring to the operations in Ava, and as a unique specimen the following extract is made; the order is dated Fort William, April 22, 1826: "The services of Superintending Surgeon Heward and the officers of the Medical Department, and of Captain Fiddes and the officers of the Commissariat are fully appreciated by His Lordship in Council. . . . The Governor-General in Council deeply laments the general sickness which attacked and utterly disabled for further effective service the South Eastern Division of the Army, and the loss of the many brave officers and men who fell victims to the noxious climate of Arracan."

The grade of Superintending Surgeon was introduced into the Company's service in 1817, and corresponded with what later was known as a senior Surgeon-Major on the staff.

On January 7, 1818, a proclamation was issued to the effect that the currency of pagodas, fanams, and cash was to be discontinued, and that all payments would in future be made in rupees, annas, and pice. A new scale of pay came into force at this time. In the Company's service a Surgeon's monthly pay was fixed at rupees 153.11.4 with batta of rupees 203.7.0, and gratuity of rupees 40.11.0. For Assistant Surgeons the pay was rupees 101.11.6, batta

rupees 135.10.0, and gratuity rupees 27.2.0. For medical officers of the King's regiments the computation of pay was somewhat complicated. All Surgeons of these units received pay from the Company at the rate of 4 rupees a day, and Assistant Surgeons at 3 rupees, reduced later to 2 rupees. They also got King's pay which varied with service. Thus a surgeon of 20 years' service got King's pay at 18 shillings and 10 pence a day, of 10 years' service at 14 shillings: and if of less than 7 years' service at 11 shillings and 4 pence. An Assistant Surgeon received 7 shillings and 6 pence a day. After conversion of these rates into rupees, any difference in excess of King's pay over the Company's pay was deducted from the batta allowance. Thus the difference for a senior Surgeon was 10 rupees monthly; for one of ten years' service it was 49 rupees, and for a junior Surgeon it was 16 rupees. The rupee was calculated to be worth two shillings and six pence halfpenny. On this principle a senior Surgeon in a 30-day month drew rupees 227 as King's pay, and 120 rupees as Company's pay; the difference of 107 rupees was then deducted from his 203 rupees batta, making that but 94 rupees. This with 40 rupees gratuity added to his King's and Company's pay made his total pay some 480 rupees a month. On the same principle the Assistant Surgeon drew about 340 rupees monthly. In his case there was no difference to deduct from the batta allowance. We can trace in these calculations how the noble rate of 317 rupees a month was arrived at, as the pay which so many of us drew for years in India; we can also see the germs of the complicated system of pay which even now prevails in India.

The following extract from a general letter from the Court of Directors, dated February 2, 1826, and addressed to the Governor-General, is of interest as showing the official method of notifying the original appointment of a medical officer to the Company's service. Many of these announcements appear in General Orders from 1760 to 1826, and perhaps later; they are always couched in the same language. "We have appointed Mr. James Hardie, now at Calcutta, an Assistant Surgeon upon your establishment, provided he is not the son of a native Indian; that he is not under 22 years of age, or exceptionable in any other respect; subject also to his being first examined and found qualified for the profession by your Medical Board. Upon your being satisfied as to the above particulars, we direct that the Governor-General in Council do administer to Mr. Hardie the usual oath of fidelity to the Company."

In closing these discursive jottings one regrets that they are so poor in detail; but anyone who has looked through old records—many in very faded and illegible writing—cannot fail to be impressed by their general meagreness both as to medical affairs generally and as to medical officers in particular. Perhaps, some day, an historian will be forthcoming who will be able to put together a full and sequential account of past military medical matters. So far, Gore is the only man who has attempted this; and to this day his work constitutes our most complete and erudite history. The series of articles which occasionally appear in our Journal as "Echoes from the Past" cannot fail to be of use to any such future historian. In this contribution one has endeavoured to work up one chapter; but even in that there are many gaps. There are many similar chapters to be dealt with. The most one can claim to have done in this effort is to place on modern record the names of some men little known in their own day, and certainly long forgotten. These men and many others not named were the forerunners of ourselves, that is of men in the Royal Army Medical Corps and in the Indian Medical Services of these times. Of them all it may be truly said in life they were *fideles in arduis*, and to that judgment we add the hope of them that in death *requiescant in pace*.

THE MORPHOLOGY OF THE TRYPANOSOME CAUSING DISEASE IN MAN IN NYASSALAND.[1]

BY SURGEON-GENERAL SIR DAVID BRUCE, C.B., F.R.S.; MAJORS DAVID HARVEY AND A. E. HAMERTON, D.S.O., R.A.M.C.; DR. J. B. DAVEY, NYASSALAND MEDICAL STAFF; AND LADY BRUCE, R.R.C.

INTRODUCTION.

THIS species, like *Trypanosoma Brucei* and *T. gambiense*, is characterized by showing two distinct forms—the long and slender, and the short and stumpy. These are not sharply divided from one another, but are connected by intermediate forms, so as to form an unbroken series, or curve, from the shortest to the longest.

This strain of the trypanosome was obtained from a native woman suffering from "Kaodzera," the so-called Sleeping Sickness of Nyassaland.

A. LIVING, UNSTAINED.

The movements of the Nyassaland trypanosome resemble *T. Brucei* and *T. gambiense* in being non-translatory either in fresh blood or in dilutions with citrate solution. Under dark background illumination, however, with a higher degree of dilution, some translatory movement is seen, the trypanosomes swimming slowly across the field.

B. FIXED AND STAINED.

The blood films were fixed, stained, and measured as previously described in the *Proceedings*.[2]

Length.—The following table gives the length of this trypanosome as found in man, monkeys, goats, sheep, dogs, guinea-pigs, and white rats—1,220 trypanosomes in all. From this it will be seen that it measures, on an average, rather more than *T. Brucei* or *T. gambiense*, but the difference is so small as to be probably of no value as a means of separating these species.

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[1] Reprinted from the *Proceedings of the Royal Society*, B, vol. lxxxv.

[2] *Roy. Soc. Proc.*, 1909, B, vol. lxxxi, pp. 16 and 17.

TABLE I.—MEASUREMENTS OF THE LENGTH OF THE TRYPANOSOME OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND.

Date	No. of experiment	Animal	Method of fixing	Method of staining	In microns: Average length	Maximum length	Minimum length
1.9.10	—	Man (P. R.)	Osmic acid	Giemsa	23·6	28·0	18·0
1.9.10	—	,, ..	,,	,,	24·3	30·0	18·0
1.9.10	—	,, ..	,,	,,	23·9	29·0	20·0
29.1.12	24	Monkey ..	,,	,,	22·1	30·0	17·0
6.2.12	24	,, ..	,,	,,	18·0	21·0	16·0
8.2.12	24	,, ..	,,	,,	19·9	29·0	16·0
15.2.12	24	,, ..	,,	,,	20·2	23·0	17·0
19.2.12	234	,, ..	,,	,,	23·0	31·0	18·0
15.2.12	142	Goat ..	,,	,,	24·3	28·0	21·0
9.2.12	163	Sheep ..	,,	,,	25·0	29·0	20·0
9.2.12	163	,, ..	,,	,,	25·1	29·0	22·0
17.2.12	164	,, ..	,,	,,	24·6	29·0	21·0
19.1.12	11	Dog ..	,,	,,	28·3	34·0	23·0
25.1.12	14	,, ..	,,	,,	25·9	32·0	17·0
29.1.12	14	,, ..	,,	,,	22·7	30·0	16·0
5.2.12	111	,, ..	,,	,,	23·4	28·0	18·0
6.2.12	111	,, ..	,,	,,	27·1	33·0	18·0
7.2.12	111	,, ..	,,	,,	25·1	31·0	17·0
8.2.12	111	,, ..	,,	,,	24·6	31·0	18·0
12.2.12	111	,, ..	,,	,,	23·7	30·0	17·0
9.2.12	111	,, ..	,,	,,	24·5	29·0	15·0
13.2.12	111	,, ..	,,	,,	20·3	27·0	16·0
15.2.12	111	,, ..	,,	,,	24·1	32·0	16·0
14.2.12	111	,, ..	,,	,,	23·2	29·0	17·0
14.2.12	111	,, ..	,,	,,	22·5	33·0	17·0
19.1.12	13	Guinea-pig	,,	,,	19·0	28·0	14·0
25.1.12	13	,,	,,	,,	24·6	36·0	16·0
29.1.12	13	,,	,,	,,	22·2	28·0	15·0
12.2.12	13	,,	,,	,,	23·1	29·0	16·0
19.2.12	165	,,	,,	,,	25·0	30·0	16·0
15.2.12	13	,,	,,	,,	21·7	28·0	16·0
19.12.11	38	Rat ..	,,	,,	26·6	33·0	20·0
22.1.12	38	,, ..	,,	,,	27·7	33·0	18·0
22.1.12	37	,, ..	,,	,,	26·7	33·0	17·0
29.1.12	36	,, ..	,,	,,	28·2	31·0	23·0
1.2.12	36	,, ..	,,	,,	26·4	33·0	22·0
6.2.12	36	,, ..	,,	,,	28·3	34·0	18·0
6.2.12	36	,, ..	,,	,,	27·2	33·0	18·0
1.2.12	36	,, ..	,,	,,	27·2	35·0	21·0
6.2.12	36	,, ..	,,	,,	28·2	31·0	19·0
20.2.12	236	,, ..	,,	,,	21·6	30·0	18·0
20.2.12	236	,, ..	,,	,,	22·7	29·0	18·0
22.2.12	235	,, ..	,,	,,	25·5	29·0	18·0
21.2.12	235	,, ..	,,	,,	25·1	29·0	19·0
21.2.12	236	,, ..	,,	,,	25·5	30·0	19·0
21.2.12	236	,, ..	,,	,,	25·1	34·0	19·0
22.2.12	235	,, ..	,,	,,	24·8	31·0	19·0
22.2.12	236	,, ..	,,	,,	24·7	33·0	18·0
22.2.12	236	,, ..	,,	,,	24·0	34·0	19·0
22.2.12	235	,, ..	,,	,,	23·5	28·0	19·0
23.2.12	235	,, ..	,,	,,	24·0	33·0	18·0
23.2.12	235	,, ..	,,	,,	25·2	32·0	19·0
23.2.12	236	,, ..	,,	,,	25·5	31·0	19·0
24.2.12	235	,, ..	,,	,,	24·4	29·0	19·0
1.2.12	36	,, ..	,,	,,	28·7	34·0	19·0
23.2.12	236	,, ..	,,	,,	24·5	34·0	18·0
24.2.12	236	,, ..	,,	,,	20·9	29·0	18·0
24.2.12	235	,, ..	,,	,,	25·4	32·0	20·0
24.2.12	236	,, ..	,,	,,	22·2	30·0	18·0
25.2.12	235	,, ..	,,	,,	21·8	31·0	16·0
26.2.12	236	,, ..	,,	,,	21·5	30·0	18·0
					24·1	36·0	14·0

The average length of the trypanosome of the human trypanosome disease of Nyassaland in man and other species of animals, taken from Table I, is as follows :—

TABLE II.

Species of animal	Number of trypanosomes measured	In microns		
		Average length	Maximum length	Minimum length
Man	60	23·9	30·0	18·0
Monkey[1]	100	20·6	31·0	16·0
Goat	20	24·3	28·0	21·0
Sheep	60	24·9	29·0	22·0
Dog	260	24·2	34·0	15·0
Guinea-pig ..	120	22·6	36·0	14·0
Rat	600	25·1	35·0	16·0

[1] Probably *Cercopithecus pygerythus*, the common grey, black-faced monkey; native name "Pusi."

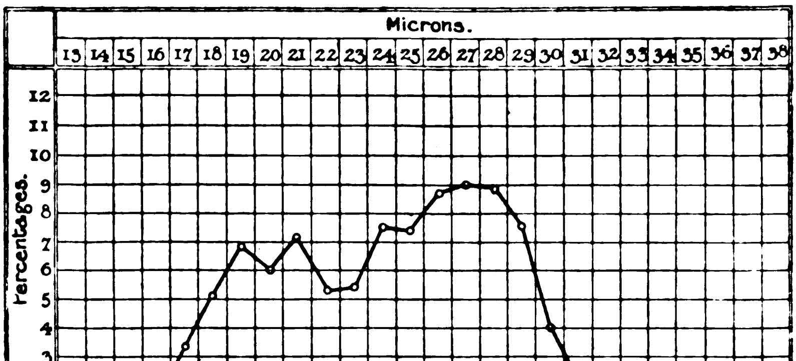


CHART 1.—Chart giving curve representing the distribution, by percentages, in respect to length, of 1,220 individuals of the trypanosome of the human trypanosome disease of Nyassaland.

This curve is made up of measurements from 60 specimens of trypanosomes taken from man, 100 from the monkey, 20 from the goat, 60 from the sheep, 260 from the dog, 120 from the guinea-pig, and 600 from the rat.

The measurements are made along the curve of the long axis of the body of the trypanosome, and therefore if an oval nucleus is lying transversely to the long axis of the trypanosome, the measurement given will not represent the greatest length of the nucleus.

Breadth.—The long and slender average 1·7 microns in breadth, the intermediate 2·1, and the short and stumpy 2·9. This measurement was made across the broadest part in 100 of each of the three varieties of this trypanosome.

Shape.—The long and slender are very similar in appearance to *T. Brucei* and *T. gambiense*, but the intermediate differ to some extent in that the posterior extremity seems often to be more elongated than in the other two species, and blunter (Plate 11, figs. 1, 2, and 3). The short and stumpy are also characterized by blunter posterior extremities, often suggesting the appearance of a hippopotamus head (Plate 11, figs. 8 and 9). On comparing these plates with those of *T. Brucei* and *T. gambiense* this difference will readily be seen.

Contents of Cell.—In well-stained films the protoplasm of many of the trypanosomes shows granules, especially in the anterior portion of the cell.

Nucleus.—The nucleus is oval in the long and slender and intermediate, and round or oval in the short and stumpy. One peculiarity about the nucleus of this species is that it is frequently placed far back in the body of the organism. This peculiarity is found in the short and stumpy non-flagellar forms (Plate 11, figs. 4 to 11), and more rarely in the intermediate (Plate 11, figs. 12 and 13); never in the long and slender. The percentage among the short and stumpy forms is often large, as will be seen by Table V. As the percentage of these non-flagellar forms is 24·8 of the whole, it is easy to calculate the percentage of the posterior nuclear forms to the whole body of this trypanosome.

Micronucleus.—Small and round, and situated, on an average, 2 microns from the posterior extremity in the long and slender, 1·6 in the intermediate, and 1·4 in the short and stumpy.

Undulating Membrane.—This, as in *T. Brucei* and *T. gambiense*, is well developed and thrown into bold folds and undulations.

Flagellum.—The flagellum in the long and slender averages 5·8 microns (maximum 11, minimum 2), and in the intermediate 3·3 microns (maximum 9, minimum 1). There is no free flagellum in the short and stumpy forms. In *T. Brucei* the short and stumpy non-flagellated forms mostly lie between 13 and 21 microns. This is not so in the trypanosome under consideration, as Table VI shows.

TABLE III.—DISTRIBUTION IN RESPECT TO LENGTH OF 1,220 INDIVIDUALS OF THE TRYPANOSOME OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND.

Animal	In microns																							Average length
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Man ..	—	—	—	—	—	—	1	4	2	—	4	3	4	1	—	1	—	—	—	—	—	—	—	23·6
,, ..	—	—	—	—	1	—	2	—	3	3	3	3	3	1	1	—	—	—	—	—	—	—	—	24·3
,, ..	—	—	—	—	1	—	1	4	—	2	2	2	2	2	3	—	1	—	—	—	—	—	—	23·9
Monkey ..	—	—	—	3	—	4	—	2	3	2	2	—	1	—	1	1	1	—	—	—	—	—	—	22·1
,, ..	—	—	2	6	5	5	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18·0
,, ..	—	—	1	5	2	4	2	1	1	1	—	2	—	—	—	1	—	—	—	—	—	—	—	19·9
,, ..	—	—	—	1	3	3	3	6	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	20·2
,, ..	—	—	—	—	1	2	3	3	—	3	3	—	1	2	—	1	—	1	—	—	—	—	—	23·0
Goat ..	—	—	—	—	—	—	—	1	2	4	5	3	2	1	2	—	—	—	—	—	—	—	—	24·3
Sheep ..	—	—	—	—	—	—	1	1	1	1	3	4	4	2	2	1	—	—	—	—	—	—	—	25·0
,, ..	—	—	—	—	—	—	—	—	3	2	4	2	2	4	2	1	—	—	—	—	—	—	—	25·9
,, ..	—	—	—	—	—	—	—	2	—	4	4	6	—	2	—	2	—	—	—	—	—	—	—	24·6
Dog ..	—	—	—	—	—	—	—	—	—	2	—	2	2	—	3	5	1	2	2	—	1	—	—	28·3
,, ..	—	—	—	1	—	—	—	—	—	—	4	3	2	7	1	1	—	—	1	—	—	—	—	25·1
,, ..	—	—	1	1	—	4	2	1	1	1	1	3	—	2	1	1	1	—	—	—	—	—	—	22·7
,, ..	—	—	—	—	1	2	3	1	2	—	1	3	2	3	2	—	—	—	—	—	—	—	—	23·4
,, ..	—	—	—	—	1	1	—	—	1	—	1	—	4	—	4	2	3	1	1	1	—	—	—	27·1
,, ..	—	—	—	1	—	2	1	—	2	—	—	3	—	6	1	2	1	1	—	—	—	—	—	25·1
,, ..	—	—	—	—	1	3	—	—	2	2	2	1	—	4	2	1	1	1	—	—	—	—	—	24·6
,, ..	—	—	—	2	2	1	—	1	—	1	2	1	6	1	2	—	1	—	—	—	—	—	—	23·7
,, ..	—	1	—	2	—	—	—	2	—	—	2	3	2	3	2	3	—	—	—	—	—	—	—	24·5
,, ..	—	—	1	3	7	2	—	—	—	2	—	1	3	1	—	—	—	—	—	—	—	—	—	20·3
,, ..	—	—	2	—	2	—	—	—	—	2	3	1	6	1	2	—	—	—	1	—	—	—	—	24·1
,, ..	—	—	—	1	3	1	—	2	2	—	3	2	1	1	2	2	—	—	—	—	—	—	—	23·2
,, ..	—	—	—	4	3	1	1	1	—	1	2	—	1	2	2	1	—	—	—	1	—	—	—	22·5
Guinea-pig	1	2	4	1	2	1	1	4	2	—	1	—	—	—	1	—	—	—	—	—	—	—	—	19·0
,,	—	—	2	1	1	—	1	—	3	—	—	2	2	2	1	1	3	—	—	—	—	—	1	24·6
,,	—	1	—	4	3	1	—	—	—	—	2	1	2	4	2	—	—	—	—	—	—	—	—	22·2
,,	—	—	1	4	1	2	—	1	—	—	—	2	1	1	5	2	—	—	—	—	—	—	—	23·1
,,	—	—	2	—	1	—	—	—	—	—	1	4	5	3	2	1	1	—	—	—	—	—	—	25·0
,,	—	—	2	1	1	2	1	3	3	—	2	1	1	2	1	—	—	—	—	—	—	—	—	21·7

Rat ..	—	—	—	—	—	—	1	1	2	—	—	3	2	4	1	2	1	1	—	2	—	—	—	26·6
,, ..	—	—	—	—	1	—	—	1	—	—	1	—	1	3	5	3	1	2	1	1	—	—	—	27·7
,, ..	—	—	—	1	1	—	1	2	—	—	—	1	1	1	4	1	3	—	3	1	—	—	—	26·7
,, ..	—	—	—	—	—	—	—	—	—	1	1	1	1	1	3	6	5	1	—	—	—	—	—	28·2
,, ..	—	—	—	—	—	—	—	—	2	2	2	1	2	4	2	3	—	1	—	1	—	—	—	26·4
,, ..	—	—	—	—	1	2	—	—	—	—	—	—	1	—	31	4	3	2	2	—	2	—	—	28·3
,, ..	—	—	—	—	1	1	2	—	—	—	1	—	1	2	2	2	4	—	3	1	—	—	—	27·2
,, ..	—	—	—	—	—	—	—	2	—	—	2	1	3	2	4	2	1	1	1	—	—	1	—	27·2
,, ..	—	—	—	—	—	1	—	—	—	—	1	—	4	1	—	3	6	4	—	—	—	—	—	28·2
,, ..	—	—	—	—	1	1	7	4	1	3	1	—	—	1	—	—	1	—	—	—	—	—	—	21·6
,, ..	—	—	—	—	2	4	4	—	—	1	1	2	—	3	2	1	—	—	—	—	—	—	—	22·7
,, ..	—	—	—	—	1	—	2	1	—	1	—	3	2	3	2	5	—	—	—	—	—	—	—	25·5
,, ..	—	—	—	—	—	1	1	3	2	—	1	2	—	2	4	4	—	—	—	—	—	—	—	25·1
,, ..	—	—	—	—	—	1	—	2	—	1	1	2	7	2	—	3	1	—	—	—	—	—	—	25·5
,, ..	—	—	—	—	—	3	1	—	2	3	—	—	3	1	2	3	1	—	—	—	1	—	—	25·1
,, ..	—	—	—	—	—	1	2	1	2	2	3	—	1	1	5	—	1	1	—	—	—	—	—	24·8
,, ..	—	—	—	—	1	1	—	3	1	3	2	2	1	1	1	—	2	1	—	1	—	—	—	24·7
,, ..	—	—	—	—	—	1	1	7	1	1	—	2	3	1	—	1	—	—	1	—	1	—	—	24·0
,, ..	—	—	—	—	—	1	2	2	3	3	3	—	2	1	3	—	—	—	—	—	—	—	—	23·5
,, ..	—	—	—	—	1	—	3	1	4	2	3	1	—	1	—	1	—	2	—	1	—	—	—	24·0
,, ..	—	—	—	—	—	1	1	3	1	1	2	—	2	2	3	2	1	—	1	—	—	—	—	25·2
,, ..	—	—	—	—	—	1	2	2	—	—	2	2	2	2	2	2	1	2	—	—	—	—	—	25·5
,, ..	—	—	—	—	—	1	2	2	3	—	—	2	4	2	2	2	—	—	—	—	—	—	—	24·4
,, ..	—	—	—	—	—	1	—	—	—	—	1	3	3	1	1	—	—	1	5	3	1	—	—	28·7
,, ..	—	—	—	—	1	1	5	—	—	3	—	2	—	2	1	2	1	1	—	—	1	—	—	24·5
,, ..	—	—	—	—	4	3	7	—	2	1	—	1	—	—	—	2	—	—	—	—	—	—	—	20·9
,, ..	—	—	—	—	—	—	1	3	1	—	3	1	1	5	3	1	—	—	1	—	—	—	—	25·4
,, ..	—	—	—	—	1	6	2	3	—	2	1	1	—	1	1	1	1	—	—	—	—	—	—	22·2
,, ..	—	—	1	—	2	6	—	3	—	1	3	—	1	1	—	1	—	1	—	—	—	—	—	21·8
,, ..	—	—	—	—	3	2	5	3	3	—	1	—	—	1	1	—	1	—	—	—	—	—	—	21·5
Total ..	1	4	19	42	63	81	75	91	65	66	93	91	107	110	104	87	49	27	23	13	7	1	1	
Percentagos	0·1	0·3	1·5	3·4	5·1	6·8	6·0	7·3	5·3	5·4	7·5	7·4	8·7	9·0	8·5	7·5	4·0	2·2	1·9	1·0	0·6	0·1	0·1	

TABLE V.—PERCENTAGE OF POSTERIOR NUCLEAR FORMS FOUND AMONG THE SHORT AND STUMPY VARIETIES OF THE TRYPANOSOME OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND.

Date	Experiment number	Animal	Percentage of short and stumpy forms	Proportion to all forms per 1,000
1912.				
March 1	233	Monkey	7	17
,, 4	233	,,	10	25
,, 14	233	,,	6	15
February 23	234	,,	21	52
March 1	234	,,	1	2
February 29	14	Dog	7	17
,, 26	157	,,	16	40
,, 29	243	,,	41	102
,, 29	13	Guinea-pig	6	15
March 18	13	,,	8	20
,, 14	165	,,	7	17
,, 18	165	,,	36	90
February 29	166	,,	17	42
March 18	239	,,	36	90
February 22	235	Rat	7	17
,, 23	235	,,	22	55
,, 27	235	,,	38	95
,, 28	235	,,	41	102
,, 29	235	,,	39	97
March 1	235	,,	51	127
,, 4	235	,,	29	72
,, 5	235	,,	30	75
,, 6	235	,,	36	90
,, 7	235	,,	30	75
,, 8	235	,,	38	95
,, 11	235	,,	39	97
,, 13	235	,,	45	112
February 27	236	,,	24	60
,, 29	236	,,	32	80
March 1	236	,,	46	115

TABLE IV.—MEASUREMENTS GIVING THE AVERAGE DISTANCE FROM THE POSTERIOR EXTREMITY TO MICRONUCLEUS, MICRONUCLEUS TO NUCLEUS, &c., IN 1,220 INDIVIDUALS OF THE TRYPANOSOME OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND.

Posterior extremity to micronucleus	Micronucleus to nucleus	Diameter to nucleus	Nucleus to anterior extremity	Flagellum
Short and stumpy (14 to 21 microns), 620 individuals.				
1·4	4·4	2·7	10·0	0·6
Intermediate (22 to 24 microns), 224 individuals.				
1·6	5·6	2·9	9·3	3·7
Long and slender (25 to 36 microns), 376 individuals.				
2·0	6·3	3·1	10·4	5·8

TABLE VI.—NUMBER OF FLAGELLATED AND NON-FLAGELLATED FORMS FOUND AMONG 1,220 TRYPANOSOMES OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND.

Length, microns	Non-flagellated	Flagel-lated	Length, microns	Non-flagellated	Flagel-lated	Length, microns	Non-flagellated	Flagel-lated
Short and stumpy			Intermediate			Long and slender		
14	1	—	22	5	60	25	—	91
15	4	—	23	2	64	26	—	107
16	19	—	24	—	93	27	—	110
17	42	—	..	..	..	28	—	104
18	62	1	..	..	..	29	—	87
19	74	7	..	..	..	30	—	49
20	56	19	..	..	..	31	—	27
21	37	54	..	..	..	32	—	23
..	..	..	..	..	..	33	—	13
..	..	..	..	..	..	34	—	7
..	..	..	..	..	..	35	—	1
..	..	..	..	..	..	36	—	1
..	295	81	..	7	217	..	0	620

The above table shows that 81 of the intermediate forms are under 22 microns in length, and that seven short and stumpy forms are above 21 in length. If the trypanosomes are separated into non-flagellar and flagellated, then there are 24·8 per cent. of the former and 75·2 per cent. of the latter.

COMPARISON OF THE TRYPANOSOME OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND WITH T. BRUCEI.

The plate which accompanies this paper, when compared with that of *T. Brucei*[1] or *T. gambiense*,[2] shows that the three species are much alike. The chief difference is the tendency of the Nyassaland trypanosome, as has already been pointed out, to show numerous posterior nuclear forms. The Commission has had no opportunity of examining *T. Brucei* for posterior nuclear forms under the same conditions as the Nyassaland organism, but it may be assumed that *T. Brucei* does not show these aberrant forms to the same extent, or the fact would have been noted long ago, no species having been studied so often or so closely as *T. Brucei*. Another difference between the two species is the occurrence of the broad, blunt-ended forms—the hippo-headed—among the short and stumpy, a form which rarely, if ever, appears in Bruce's trypanosome.

[1] *Roy. Soc. Proc.*, 1911, B, vol. lxxxiii, Plate 2.
[2] *Ibid.*, vol. lxxxiv, Plate 13.

But when we compare the curves representing the distribution by percentages in respect to length of 1,000 and 1,220 individuals of each species, the similarity of the two parasites is remarkable. In *T. Brucei* there are 26 per cent non-flagellated forms, in the trypanosome of Nyassaland 25 per cent.

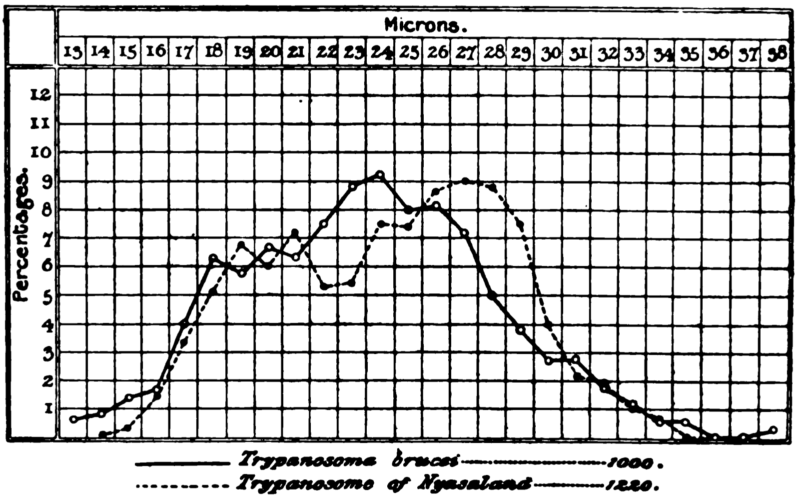


CHART 2.—Chart giving curves representing the distribution, by percentages, in respect to length, of 1,000 individuals of *T. Brucei*, and 1,220 individuals of the trypanosome of the human trypanosome disease of Nyassaland.

Again, if we divide the 1,220 Nyassaland trypanosomes, by length, into short and stumpy (13-21 microns), intermediate (22-24 microns), and long and slender (25 microns and upwards), as has been done in the case of *T. Brucei* and *T. gambiense*, the result is as follows:—

	Short and stumpy	Intermediate	Long and slender
T. gambiense	51·2	23·1	25·7
T. Brucei	32·8	25·5	41·7
Nyassaland trypanosome	30·8	18·4	50·8

This shows the percentage of the short and stumpy to be almost the same in *T. Brucei* and the Nyassaland trypanosome, and the latter to be rather better off in the long and slender forms.

COMPARISON OF THE TRYPANOSOME OF THE HUMAN TRYPANOSOME DISEASE OF NYASSALAND WITH *T. rhodesiense* (STEPHENS AND FANTHAM).

Dr. J. W. W. Stephens, of the Liverpool School of Tropical Medicine, at Sir David Bruce's request, kindly measured 1,000

trypanosomes of the strain from a case of sleeping sickness from the Luangwa Valley, North-east Rhodesia, which he has named *T. rhodesiense.* This proposed new species is characterized by posterior nuclear forms, and a snout-like prolongation of the posterior extremity. These are also, as we have seen, characteristics of the Nyassaland trypanosome. The following chart has been prepared from the figures supplied by Dr. Stephens, and shows that the similarity of the curve prepared from 1,000 individuals of *T. rhodesiense* to that prepared from 1,220 individuals of the Nyassaland trypanosome is still more remarkable than in the case of *T. Brucei.* Dr. Stephens measured 100 trypanosomes from man, 40 from the monkey, 40 from the horse, 40 from the dog, 40 from the rabbit, 100 from the guinea-pig, 600 from the rat, and 40 from the mouse.

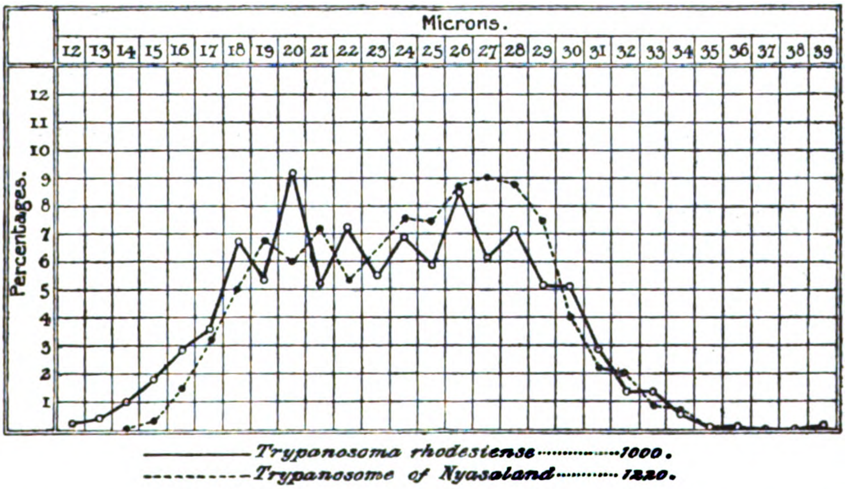


CHART 3.—Chart giving curves representing the distribution, by percentages, in respect to length, of 1,000 individuals of *T. rhodesiense*, and 1,220 individuals of the trypanosome of the human trypanosome disease of Nyassaland.

CONCLUSIONS.

(1) The trypanosome of the human trypanosome disease of Nyassaland is *T. rhodesiense* (Stephens and Fantham).

(2) This is a distinct species, nearly related to *T. Brucei* and *T. gambiense*, but more closely resembling the former than the latter.

(3) From this it follows that the human trypanosome disease of North-east Rhodesia and Nyassaland is not the disease known as sleeping sickness in Uganda and the West Coast of Africa.

(4) The native name "kaodzera" might be used for this new disease to distinguish it from the older known sleeping sickness.

DESCRIPTION OF PLATE.

PLATE 11.

T. rhodesiense, posterior nuclear and blunt, hippo-headed forms found commonly in this species. × 2,000.

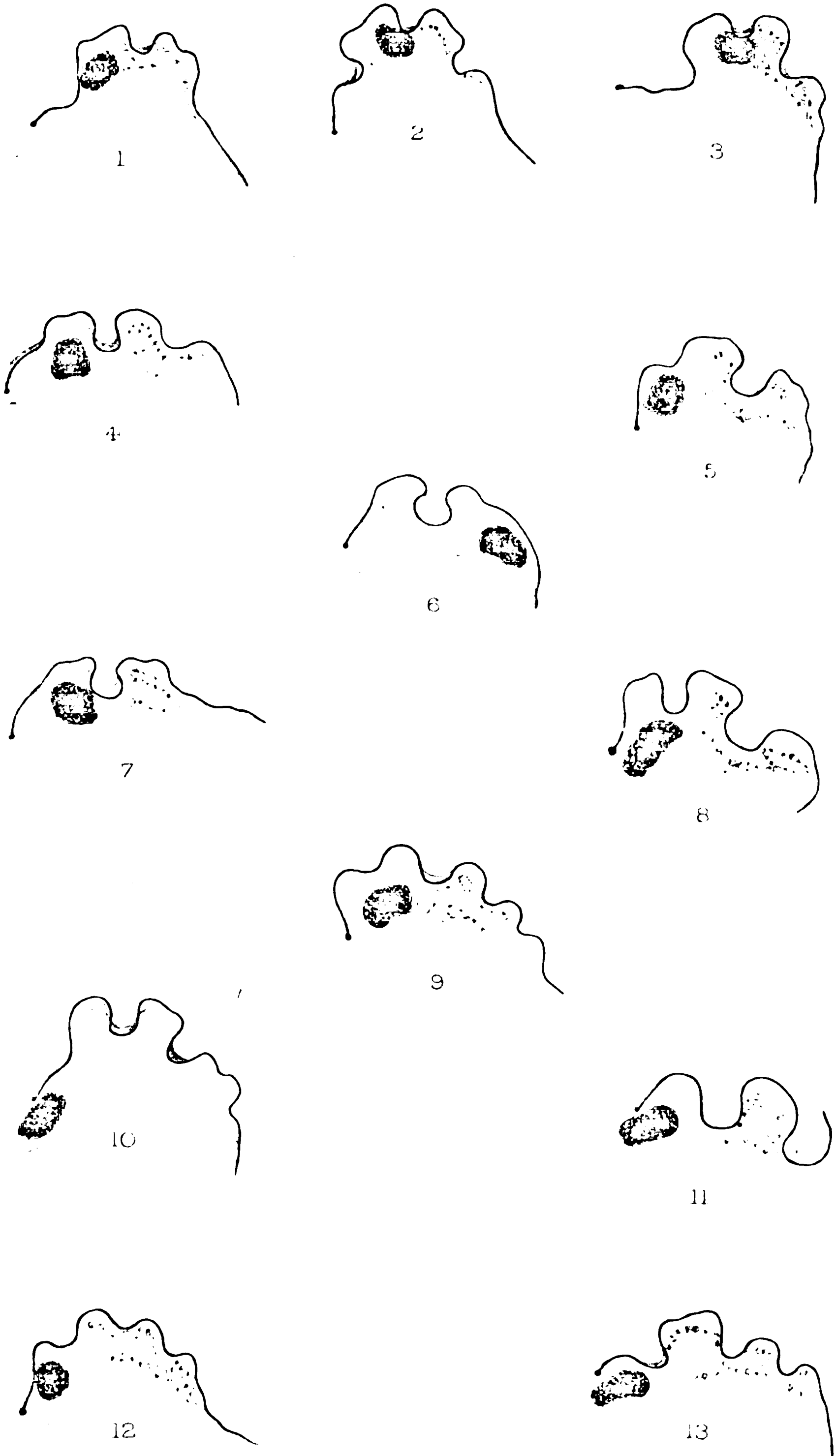
Figs. 1, 2 and 3.—Intermediate forms with blunt posterior extremities.

Figs. 4, 5, 7, 8, 9, 10 and 11.—Posterior nuclear forms.

Fig. 6.—Nucleus near anterior extremity.

Figs. 12 and 13.—Posterior nuclear intermediate forms.

NOTE.—Only one Plate has been reproduced.



To illustrate "The Morphology of the Trypanosome Causing Disease in Man in Nyasaland."

By Surgeon-General Sir DAVID BRUCE, C.B., F.R.S.; Majors DAVID HARVEY and A. E. HAMERTON, D.S.O., R.A.M.C.; Dr. J. B. DAVEY, Nyasaland Medical Staff; and Lady BRUCE, R.R.C.

THE DIAGNOSIS AND MANAGEMENT OF EARLY PHTHISIS.

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In no department of medicine has our outlook altered of late years so much as in connexion with phthisis. It is within the recollection of many of us that not long ago a diagnosis of tubercle of the lung was equivalent to a sentence of death, and that cases which did recover after such a diagnosis were looked upon as something of a marvel. Yet the experience of post-mortem examinations, even in those days, taught us again and again that a very large percentage of the population at one time or another during their life did suffer from tubercular disease of the lungs, which passed unrecognized and recovered spontaneously. The lesson to be derived from this was that phthisis could exist without any sign of its presence which could be recognized by the methods of examination which were in vogue in those days, and that the cases of tubercular disease of the lungs which were serious were those which had progressed so far as to produce lesions which could be detected by the ordinary methods of physical examination. Various symptoms were recognized, however, as common forerunners of florid phthisis, symptoms which were, and still are, frequently called those of the "pre-tubercular stage"; it is a term which is peculiarly inappropriate since it connotes the idea that the anæmia, the slight fever and so on which precede the appearance of manifest phthisis are symptoms of a special susceptibility to tubercular infection; whereas, as we know now, these symptoms are actual evidence of infection by the tubercle bacillus. The only legitimate use of the word "pre-tubercular" would appear to be in connexion with those peculiarities of body structure which are generally recognized as being associated with a special susceptibility to tubercular disease, the long thin flattened chest, the regular features, fine skin, highly strung temperament, &c.

Tuberculosis is an insidious disease, generally slow in onset, and it tends to advance steadily if the conditions under which it arose are allowed to continue, but in a great many cases if the patient is submitted to modern treatment at a sufficiently early stage it is a disease which is eminently curable; when, however, it has passed beyond the early stage, when there are marked physical

signs, fever, sweats, and quantities of tubercle bacilli in the sputum it becomes a very serious matter. Nothing stands out more clearly in the statistics of sanatoria than the fact that the earlier the case is put under treatment the better is the prognosis. It follows that the chief hope of improvement in the treatment of phthisis rests in the use of methods which shall secure early recognition of the disease, before marked physical signs are present, before fever and sweats make the condition obvious and before tubercle bacilli appear in the sputum. In the Army we are in a specially favourable position for attaining this object, we have the men constantly under our eyes, the conditions of a soldier's work compel him to report sick if he finds himself unable to work at the same rate as his healthy comrades, and when he does go on the sick list he is treated in a hospital where it is possible to observe his symptoms infinitely better than is the case with the civilian, who is either seen casually at a surgery or, if he is attended to at his own home, is only seen once a day and is completely removed from skilled observation in the intervals.

The symptoms which may give rise to a suspicion of phthisis are as follows: There is a gradual deterioration of the general health, the patient loses his energy and becomes easily tired; this may be interspersed with periods of exceptional vigour, and in the case of an intellectual man with periods of remarkable brilliancy. The patient usually loses colour and becomes thin; loss of weight is an extremely important symptom in a man, men do not lose weight without serious cause; with women it is different, a woman may lose weight and even become emaciated from emotional causes alone. Loss of appetite, dyspepsia, and evening headaches are frequent phenomena, whilst even in quite early cases one can often elicit a history of night sweats. Cough may be entirely absent, or may amount to no more than a slight morning cough with expectoration of a little mucus, or muco-pus, in other cases it may be the most prominent feature of the case, and appear as a worrying dry cough which is worst at night and keeps the patient awake. Sometimes the cough causes so little inconvenience that the patient may deny that he has a cough at all, even though he has actually been coughing in one's presence.

The cough of the early stages is largely due to irritation of the lung tissues, and not so much to the necessity for expectorating pathological secretions; so that as a rule, sputum at this stage is scanty or absent, and in really early phthisis it contains tubercle bacilli only in about 10 per cent of cases. This is a sufficient

comment on the frequent practice of ignoring all the other phenomena, and insisting on the finding of tubercle bacilli in the sputum before making the diagnosis. Hæmoptysis is always recognized as an extremely suspicious symptom; to be of importance it must amount to more than a mere streak of blood on an odd sample of sputum; and it has to be remembered that other diseases, mitral stenosis for example, can also cause marked hæmoptysis. Stabbing pains in the chest occur in many quite early cases; they may be due either to a small patch of pleurisy over a tubercular focus, or to intercostal neuralgia consequent on irritation of the visceral nerves belonging to the same spinal segment. This irritation of the visceral nerves may also cause patches of hyperæsthesia over the whole or part of the peripheral distribution of the corresponding somatic nerves; in still other cases it may produce trophic phenomena in the muscles, atrophy or irritability.

Changes in the voice, hoarseness, alteration of pitch or loss of resonance are sometimes present even when the larynx is still unaffected.

Fever, especially after exercise and in the evening, is frequent; in really early cases it may be very slight, and the patient may deny that he ever has fever, though he may confess to the loss of appetite, headaches and general malaise which usually accompany slight fever. In other cases the patient may suffer from fever which he himself recognizes as fever, and he may say that he dates his illness from several attacks of "influenza," or that he is always getting "feverish colds," the "influenza" or the "feverish colds" being really tubercular fever. When the fever is associated with night sweats the suspicion of tuberculosis is so pronounced that only very definite evidence of another cause for it justifies one in excluding phthisis. When the patient is put under hospital conditions, and especially if he is put to bed, the slight fever and attendant phenomena may subside very promptly, and may not recur until the patient resumes his ordinary duties; such cases run some risk of being classed as malingerers, since they keep perfectly well in hospital and complain only when the exercise involved in their work produces excessive auto-inoculation and a relapse of their symptoms. Primary pleurisy is tubercular in a large percentage of cases, 70 per cent at least, and opinions differ as to the frequency with which this form of pleurisy is followed by definite phthisis. It largely depends on the subsequent treatment of the case; where the patient is well treated at the beginning, and afterwards returns to an open air life with abundant food, no further trouble may

ensue; indeed, there is a good deal of reason for believing that under such conditions a primary pleurisy may act as an immunizing process. But if the case is not thoroughly well treated at the beginning, if the patient is allowed to return to work too early, or if he is allowed to return to unfavourable surroundings, or to continue such habits as over-indulgence in alcohol, or yield to other excesses, primary pleurisy is only too often followed by florid phthisis.

With regard to physical signs in the chest, it cannot be too strongly emphasized that phthisis may progress to quite a considerable extent without any abnormal physical signs whatever, or if there are changes on percussion or auscultation they are vague in character and their value depends on the concomitant general symptoms. At the most in early cases there may be some slight loss of resonance at the top of one or other lobe, or some defect in air entry over these situations; or again, if the case is more advanced, one may discover cog-wheel inspiration or harsh breathing. Crepitations when they occur are very significant, especially if they are constantly present over the same area; if they are confined to one apex they are still more suggestive; sometimes crepitations can only be brought out by making the patient cough vigorously four or five times, when the following inspirations may be accompanied by a shower of fine moist sounds. It is to be noted that tubercular disease does not always start at the apex of the lung; in some cases the first signs are to be found at the bases or over the tips of the lower lobes. In the case of a patient who has never been abroad the symptoms which I have enumerated—debility, pallor, wasting, slight fever, and cough—would always arouse the strongest suspicion of phthisis; when, however, the subject has been exposed to tropical influences the question is complicated by the possibilities of the symptoms being due to malaria, Malta fever, liver abscess, ankylostomiasis or other tropical disease, and these have to be eliminated. Malta fever, in its slighter intermittent forms, is especially apt to simulate phthisis, causing as it does fever of a hectic type, wasting, pallor, copious sweats and not infrequently a worrying cough; the same might be said for some cases of liver abscess. The tropical practitioner will naturally look for a tropical cause first, but it must not be forgotten that phthisis is just as frequent in the Tropics as it is in this country.

In many cases the history alone would justify one in diagnosing tubercle of the lung, even in the absence of signs of consolidation in the lung or of tubercle bacilli in the sputum. An example of such a case is the following: The patient had an illness in Egypt

which was labelled debility; he never had any very definite symptoms, but always felt tired, and now and again he suffered from slight fever. On his return to England he developed a morning cough, nothing to cause alarm and it was unaccompanied by any sputum, he still felt out of sorts, got easily tired and he found he was getting thinner; occasionally he sweated profusely at night. Then he reported sick on account of a stabbing pain below the left clavicle; pleuritic friction was heard over this area for one day, but later examination failed to disclose any abnormality except perhaps some defect in air entry over the left apex. In this case there came the sudden development of a patch of pleurisy over one apex to clinch the diagnosis. But even before this the history was practically diagnostic of phthisis if one could exclude the tropical diseases. When the history and physical signs are only sufficient to raise a suspicion of tubercular disease and when, as is so frequently the case, tubercle bacilli cannot be found in the sputum by ordinary methods of examination, one has to fall back on other procedures to complete the diagnosis; the antiformin treatment of the sputum, animal inoculation of sputum, tuberculin tests and the estimation of the opsonic index. Details of these methods are given below.

Antiformin Method.—This naturally is of use only when a fair amount of sputum is available. The formula for antiformin is 15 per cent solution of caustic soda and liquor sodæ chlorinata equal parts; 3 c.c. of this mixture are shaken with 10 c.c. of sputum, the specimen is then allowed to stand for twenty-four hours, the sediment washed with distilled water, centrifuged and stained in the ordinary fashion for tubercle bacilli. Various modifications of the method have been recommended with a view to securing better depositions of the bacilli, but my experience both of the original process and of its modifications has been unsatisfactory, possibly because we chiefly deal with early phthisis; in very few cases have I been able to find tubercle bacilli by this method which were not demonstrable by the ordinary processes. Another disadvantage, so far as early cases are concerned, is that in these patients sputum is often either absent or extremely scanty.

Animal Inoculation of Sputum.—This is an extremely delicate test for the presence of tubercle bacilli in pathological material, the disadvantage is that it takes three or four weeks before the typical tubercular bubo develops in the guinea-pig's groin; and, in this country at any rate, it is necessary to have a licence to perform the operation.

Tuberculin Tests.—Three of these tests have been in general use.

Von Pirquet's Test.—A couple of areas about ¼ in. diameter are scratched on the skin, one of these areas is left as a control and to the other is applied a solution of old tuberculin (50 per cent in cases of adults, 25 per cent for children). When a tubercular focus is present in the patient's body the area to which tuberculin has been applied develops into a dull red slightly raised plaque with a surrounding pink areola; the plaque appears after twenty-four to forty-eight hours, and lasts for several days, it often leaves for some time longer a pigmented scaling patch rather suggestive of a tuberculide. The control patch should show nothing but a traumatic erythema which disappears after twenty-four hours at the latest.

The method is so very sensitive that it produces a positive reaction in most adults. It tells nothing as to whether the infection is active, latent or extinct, and nothing as to the site of the tubercular lesion. In children under 12 the method is useful since, at this age, whatever tubercular infection it reveals must necessarily be recent. In adults the only result that is of value is a negative reaction, when this is found it serves definitely to exclude the idea of tuberculosis except in advanced cachexia.

A modification of von Pirquet's test is done by inunction of Moro's ointment on the unbroken skin. The formula for this ointment is equal parts of old tuberculin and lanoline. A positive reaction consists in the development of a crop of papules over the area treated with the ointment. The method has the same diagnostic significance as von Pirquet's test, but it is not quite so delicate.

Calmette's Reaction.—This consists in dropping a suitably prepared solution of tuberculin into the conjunctival sac. Several accidents have occurred from its use and it is not to be recommended.

Hypodermic Injection of Old Tuberculin.—This test is only available in non-febrile subjects. The patient should be put to bed for three days and his temperature taken, in the mouth, every four hours. If the temperature does not rise above 99·2° F. the test can be applied.

The material used is old tuberculin (Tuberculin, Koch); of this two solutions are necessary, a $\frac{1}{100}$ and a $\frac{1}{1000}$ dilution; the simplest method to make these dilutions and to avoid waste is as follows: Sterilize three test tubes in the flame and allow to cool, then with

a sterile capillary pipette make a $\frac{1}{10}$ dilution of tuberculin with normal saline containing $\frac{1}{2}$ per cent carbolic acid; place this in the first test tube and mark it distinctly (10); take a portion of this dilution and mix it with 9 volumes of the carbolized saline, giving $\frac{1}{100}$ dilution, place this in the second tube and mark that distinctly (100); the $\frac{1}{1000}$ dilution is made in a similar way by diluting the $\frac{1}{100}$ ten times, it is placed in the third tube and clearly marked (1,000). It is well to throw away the $\frac{1}{10}$ dilution as soon as the others are made so as to reduce any risk of confusion between the tubes, and for the same reason the marking of the tubes should never on any account be omitted. The initial dose is usually $\frac{1}{5}$ mg., i.e., $\frac{1}{5}$ c.c. of a $\frac{1}{1000}$ dilution; this is injected under the skin of the forearm. A positive reaction consists in (1) a red and tender swelling at the site of inoculation; (2) fever exceeding 100° F. and commencing six to thirty hours after the injection; (3) focal signs in the lungs, e.g., the appearance of crepitations which were not present before, or a considerable increase in the adventitious sounds which were already present. Of these results the focal signs are the most important, since they tell one not only that the patient is tubercular, but that the lesion is in the lung. In many cases the initial dose of $\frac{1}{5}$ mg. causes no reaction, the dose is then increased to 1 mg. (1 c.c. of $\frac{1}{1000}$ dilution), leaving an interval of two clear days before its administration. If this fails to cause a reaction a third dose of 5 mg. ($\frac{1}{2}$ c.c. of $\frac{1}{100}$ dilution) is given, again after an interval of two clear days. In some cases a final dose of 10 mg. (1 c.c. of $\frac{1}{100}$ dilution) is necessary before excluding the idea of tuberculosis; but, as a rule, it will be found that one or other of the smaller doses is sufficient to cause a reaction in a tubercular subject. When the reaction is doubtful, when for example, the temperature rises only to a little over 99° F. and there are no focal signs, the subsequent dose should not be increased, since experience has shown that an increase in the dose under such circumstances is apt to produce an excessive reaction. The rule in this case is to repeat the dose which caused the doubtful reaction. As to the significance of the three elements in the reaction the fever and inflammation round the point of inoculation only inform one that there is an active tubercular focus somewhere in the patient's body; the focal reaction shows where the lesion actually is.

The doses which are recommended are well within the limits of those which will produce disturbance in a non-infected subject; Koch gave the maximum non-toxic dose for a healthy

man as 25 mg. As regards the significance of a reaction to a certain dose, it may be taken broadly that early active cases tend to react to small doses, whilst older and partially quiescent cases require a larger amount of tuberculin to bring out the characteristic phenomena. The safety of the method has been established in many thousands of cases, but it is necessary to observe the rules laid down. The hypodermic use of old tuberculin for diagnostic purposes is contra-indicated if the patient's temperature in the mouth exceeds 99·2° F., if there has been recent hæmoptysis, where there is non-compensated heart disease, and where there is kidney disease, epilepsy or hysteria. It is advisable not to use the test within one week preceding a menstrual period, and it is not to be recommended where the diagnosis has already been made on other grounds.

Estimation of the Opsonic Index.—When the diagnostic injection of old tuberculin is contra-indicated by any of the conditions mentioned above it is necessary to fall back on the estimation of the opsonic index. It may be said at once that this test can only be carried out satisfactorily by a skilled pathologist who has had very considerable personal experience of the method. It is desirable that the patient should be put to bed for two or three days before taking the samples of blood, these are obtained from the finger, half a capsule being sufficient. Similar samples of blood should be taken from two or three normal individuals at the same time as the specimen from the patient. Care should be taken to get a good flow of blood without excessive squeezing, this is secured by making a good bold puncture with a glass pricker or with a stout Hagedorn needle. In sealing the samples great care should be taken to avoid heating the blood, and the capsules should be put away in a box as soon as possible after labelling so as to avoid unnecessary exposure to light. The tests should be carried out within twenty-four hours after taking the samples. In cases where the blood is sent to a distant laboratory for examination it is useless to send samples from the patient alone, they must be accompanied by capsules of blood from two or three normal individuals, each properly labelled ; it is also well worth noting that the specimens should be timed to arrive on a working day, so that it is better to start a series of examinations at the beginning of the week. The most convenient material for the emulsion is "Tubercle bacilli for opsonin estimation (Human)," which is prepared by the Lister Institute, and sold by Messrs. Allen and Hanbury. The emulsion is made as follows: A few crumbs of the bacilli are placed in a

watch glass and ground down to a fine powder with the rounded end of a glass rod, a minute quantity of distilled water is added by degrees, and the material worked into a smooth paste, more water is then added to form a fairly thick emulsion; this is centrifuged for three minutes to get rid of large clumps, the supernatent emulsion is then taken into another tube and centrifuged for half an hour to an hour in order to throw down the bacilli; the sediment, which now consists of a homogeneous paste of washed bacilli, is taken and made into an emulsion with normal saline, it is centrifuged for three minutes to separate clumps, and finally diluted with normal saline until it is of the consistence which experience tells one will give from 2—5 bacilli per phagocyte with a normal serum. If there is any doubt as to the emulsion being of the correct strength a trial test can be made with a normal serum. Such an emulsion, which it will be observed takes some trouble to prepare, can be kept for a fortnight on ice without deterioration, but if it is used after being on ice it should be warmed up sufficiently to avoid chilling of the phagocytes before making the usual mixtures. The blood cells are washed in the ordinary way for opsonin work. The mixtures used are equal parts of serum, blood cells and emulsion; these must be thoroughly mixed by drawing them in and expelling them from the pipette several times before eventually taking them into the tubes and sealing them, they are incubated in a water bath (a saucepan does very well) at 38° C. for fifteen minutes, then again thoroughly mixed, before making the smears, by drawing them in and out of the pipettes several times so as to dislodge the phagocytes which stick to the walls of the tubes. My own practice is to make separate specimens for each normal serum; in this way one secures a good check on the technique.

The smears are fixed by soaking for two minutes in saturated solution of corrosive sublimate, and after a good washing are stained in a bath of carbol-fuchsin at a temperature of 60° C., for half an hour; it is important not to exceed this temperature; the films are then decolorized with 2 per cent H_2SO_4 until they are just pink after washing, they are again douched thoroughly under the tap and then treated with water containing about 1 per cent of carbonate of soda; this neutralizes any remaining acidity and permits of the nuclei of the phagocytes staining properly. After a light washing the films are stained with methylene blue until the nuclei of the phagocytes and their cytoplasm are clearly defined when viewed with a $\frac{2}{3}$ in. objective. After a final washing the films are ready for examination. Satisfactory

specimens should have the cytoplasm of the leucocytes clearly defined; there should be about 2 to 6 bacteria per phagocyte and there should be very few phagocytes containing clumps of bacteria. Not less than fifty cells should be counted in each film and the specimens should be examined, each of them, in the same way. I usually start at the top left hand corner and work along the edge from left to right. The counts of the normal specimens should all come within the limits of normal variations, i.e., they should have an opsonic index as compared with each other of not less than 0·8 or more than 1·2, in most cases with good technique the normal counts come out almost identical.

In order to form a satisfactory opinion the opsonic index should be taken three or four times at least, either daily or twice a day. If the patient is actively tubercular there may be found one or other of the following conditions present: (1) The index may remain consistently below 0·8; (2) it may be every time above 1·2; (3) it may vary within wide limits. If, say on the third examination, it is found that the opsonic index has remained within normal limits an attempt should be made to see the effect of auto-inoculation; the patient may, for example, be allowed to sit up or, if his condition permits, he may be told to take a walk of a mile or so; another method is to make the patient practise deep breathing for a few minutes. The blood is taken before, one hour after and again twenty-four hours after the auto-inoculating process. A simple way of obtaining the same result is to give the patient a minute dose of old tuberculin, $\frac{1}{10}$ mg. is a suitable amount for this purpose and can be safely used even when the patient has moderate fever, this will almost invariably produce a marked wave in the curve of the opsonic index if the patient is tubercular. If the opsonic index keeps steadily within normal limits in spite of auto-inoculation or the injection of old tuberculin it is extremely improbable that the patient is actively tubercular. It will be appreciated that the use of the opsonic index for diagnostic purposes involves very considerable trouble and a large expenditure of time, so that it is not a thing which one undertakes lightly if the diagnosis can be arrived at safely by other means, at the same time there are cases in which it is essential to carry out the test if one is to form a correct judgment as to the cause of the patient's illness.

Management of Early Cases of Phthisis.—Once the diagnosis of early phthisis has been made the patient should be transferred as

soon as possible to a proper sanatorium, but as there are inevitable delays before this can be accomplished he should be put at once under conditions as nearly as possible like those of a sanatorium. He should be isolated from his fellows, whether tubercle bacilli are found in his sputum or not, and should be placed in a large airy room with all the windows open or better still under a verandah or outside under a shady tree; the place selected should not be exposed to high winds or dust and in the Tropics it should be shaded from the sun, and the patient should be protected at night from mosquitoes by means of a net or punkah. Whenever it is possible a case in the Tropics should be transferred to the hills pending the beginning of the trooping season; in this matter one has to run a certain amount of risk with hæmoptysis cases, but it is essential to get the patient away from heat, dust, flies and malaria and one can often compromise by choosing one of the lower hill stations for such cases. Recent hæmoptysis may also contra-indicate an immediate sea voyage; in this event the voyage may be postponed until the hæmoptysis has been in abeyance for a month or so. On board ship there is especial necessity for isolation of phthisis cases since the cramped quarters of a ship are peculiarly favourable to the spread of infection; in this respect it has to be remembered that the dangerous material is not the gross lumps of sputum which can be so easily dealt with, but the spray which the patient ejects whenever he coughs and which may contain tubercle bacilli even when one has failed to find them under the microscope. In choosing a suitable place for locating tubercular patients on a ship every attention should be paid to securing free ventilation and, as far as possible, the conditions of an open-air life. In most cases, unless the weather is particularly bad, they are best kept out on a reserved portion of the deck. Sea-sickness is especially to be dreaded in hæmoptysis cases; the use of sedatives and the recumbent position are very necessary to reduce this risk.

With regard to the general treatment of phthisis cases, patients with fever should be put to bed and kept there till the temperature goes down; a good rule is to keep the patient in bed whenever the evening temperature rises above 100° F., or whenever the evening pulse-rate exceeds 100. If the fever does not subside after simple rest in bed the rest must be made absolute, that is to say the patient must be treated like a case of typhoid fever, he must lie perfectly quiet, neither talking nor reading, he must be fed with a feeding cup and he must pass his dejecta into

a bed pan. Severe coughing helps to keep up fever by inducing repeated auto-inoculation; it should be kept in subjection by the use of sedatives, of which codeine is perhaps the best. After the fever has subsided the restrictions can be relaxed gradually until the patient is able to be up for the best part of the day. Patients who are allowed up should follow the ordinary sanatorium rule and rest quietly on a bed or couch for three-quarters of an hour before and after the mid-day meal; any recrudescence of fever or constitutional symptoms necessitates a return to bed. Smoking should be restricted in amount and should be allowed only at definite hours three times a day, otherwise it will be found that patients are apt to smoke from morn till dusk.

For exercise, the only form that can be regulated easily in an ordinary hospital is walking exercise. This should commence with a ¼ mile a day for a week, the distance is then extended to ½ mile, then to 2 miles, and lastly to 6 miles a day, each stage up to the last being continued for a week; the temperature should be taken one hour after the completion of the daily exercise, any return of fever or of constitutional symptoms, such as headache, malaise, or loss of appetite, necessitates either a reduction in the amount of exercise or a return to bed; if rest in bed is called for on account of over-exercise, the patient can usually return to an amount of exercise one stage less than the one which upset him. Diet should be generous, and should contain a high proportion of animal proteids and of fat, but it is not necessary to stuff the patient with food which he cannot digest; where there is difficulty in feeding, massage of the limbs for ten to fifteen minutes daily is often useful, and in many cases a glass of beer with the midday meal is a help to the appetite and to digestion. Cod-liver oil has had a reputation for many years in the treatment of tuberculosis and, whatever its mode of action, there seems to be no doubt that it is beneficial when the patient is able to digest it; experience seems also to show that other fats do not form efficient substitutes for it. It is best given in the form of an emulsion after meals, the emulsion can be prepared by the compounder and need not necessarily be one of the proprietary preparations, which are expensive.

A very good index of a patient's progress is to be found in his weight; this should be taken weekly; it is a good rule to have a weighing day for each ward so as to ensure that the matter is not forgotten; the weights should be recorded on the temperature chart, which should always be kept in custody of the sister or wardmaster;

if the charts are left by the patients' bedside one finds that they brood over them, especially if things are not going well.

With regard to specific therapy, a large number of patients do very well without anything of this kind; at the same time there is no doubt that vaccine therapy is often extremely useful, and this is especially the case with mixed infections. It not infrequently happens that it is the advent of a mixed infection which has brought the man to hospital; his tuberculosis has, perhaps, been going on quietly, causing little trouble, until he caught a pneumococcus or catarrhalis cold, or until, say, a streptococcus infection was implanted on his previous trouble; thereafter followed an acute exacerbation with fever, and increased cough.

In such cases one often finds that if one deals with the mixed infection the mischief will quieten down until the case resumes the course of a chronic phthisis. If the measures which have been indicated above do not suffice to bring about a cessation of fever, it is desirable to have a bacteriological examination made of the sputum and a suitable vaccine prepared. The sample of sputum taken for this purpose should be as free as possible from mouth organisms, and the easiest way to obtain it is to make the patient open his mouth as wide as possible, and to give one vigorous cough on to a sterile plate (a dinner plate will do if it has been scalded); the fragment of sputum thus ejected should be lifted with sterile forceps and placed in a sterile bottle for transmission to a laboratory; it is well also to make two or three smears of the sputum to accompany the specimen. It is unnecessary here to enter into details as to the method of preparing a vaccine, suffice it to mention that the most generally useful medium for sputum is blood agar. The following initial doses of vaccines are suitable:—

M. catarrhalis	.. .. ..	20—50 millions
B. friedländer	.. .. ..	20—50 ,,
Streptococci ..	.. .. ..	10—20 ,,
Pneumococci	.. .. ..	10—20 ,,

It is as well to start with small doses and increase gradually, giving such an amount of vaccine as will produce no more than a slight rise of temperature or a slight increase in the catarrhal signs in the chest; the intervals between the doses should be seven to ten days. If the vaccine is doing good there will be a considerable reduction in cough and in the amount of sputum, the catarrhal signs in the chest will diminish, the fever subside, and the patient's general condition improve. Thereafter one can commence the administration of tuberculin. It would be impossible within the

limits of this article to enter into all the details of the various methods for the administration of tuberculin; for these I must refer the reader to the many handbooks on the subject, of which perhaps, the one by Bandelier and Roepke is the most comprehensive. There are almost as many methods as men; for my own part I have a preference for small doses of "tuberculin, bacillary emulsion" (T.B.E.) I generally start with a dose of $\frac{1}{10000}$ mg. ($\frac{1}{10}$ c.c. of $\frac{1}{5000}$ dilution); if that dose does not produce fever or other disturbance I increase to $\frac{1}{5000}$ mg. ($\frac{1}{5}$ c.c. $\frac{1}{5000}$ dilution) and then to $\frac{1}{2500}$ mg., with intervals of a week between the doses. It will be usually found that these doses are well borne and, since the patient is only going to be kept until his transfer to a sanatorium, it is unnecessary to enter here into the question, a very much debated one, as to whether the doses should be pushed on to a higher level or not; the decision as to that will rest with the medical officer in charge of the sanatorium.

With treatment on the lines which have been sketched out above, a good proportion of early cases will go on to the sanatorium already in a fair way to recovery; there will, however, be some who are at a standstill, and others, a minority fortunately, who will go downhill as fast as ever they can. These last cases should be removed from contact with their more fortunate comrades; nothing is more depressing to the other patients in a phthisis ward than to have in it one of these acute cases getting visibly worse day by day. One has only to imagine what the effect of such a gloomy picture would have on oneself under such circumstances. Hope is everything to a man with consumption, and I am not at all sure that a great deal of the good effect of a sanatorium does not depend on the fact that the patient feels that he has gone there to be cured, and that the things which the doctors are doing to him are done as part of a definite plan for bringing about that happy event.

PARATYPHOID FEVER. AN ACCOUNT OF TWO EPIDEMICS, WITH REMARKS ON SOME CLINICAL FEATURES OF THE DISEASE.

By Major A. H. SAFFORD.
Royal Army Medical Corps.

In this paper all cases referred to as paratyphoid are of the "A" variety. In no case has the *B. paratyphosus* "B" been isolated.

PART I.

The first outbreak occurred at Fyzabad, India, early in March, 1912. Being in charge of the special ward at the Station Hospital, I had the advantage of having the cases under my care and also of doing the bacteriological work. The following table gives all the cases of fever, including paratyphoid, admitted to the Station Hospital from January 1, 1912:—

(1)	(2) Name	(3) Unit	(4) Company	(5) Barrack room	(6) Date of admission	(7) Illness commenced	(8) Disease probably contracted on or about	(9) Blood Culture: Day of disease	(9) Blood Culture: Result	(10) Remarks and final diagnosis
	Pte. M.	E. Yorks.	"D"	16	18.1.12	10.1.12	29.12.11	9th	Sterile	Pyrexia (a suspicious case of paratyphoid.
	„ Gi.	„	"G"	15	27.1.12	24.1.12	12.1.12	7th	„	Hepatitis.
	„ R.	„	"E"	9	13.2.12	9.2.12	28.1.12	6th	„	Pyrexia (a doubtful case).
	„ Br.	„	"F"	11	29.2.12	24.2.12	12.2.12	8th	„	Pyrexia.
(1)	Pte. Go.	„	"G"	110	2.3.12	28.2.12	16.2.12	5th	Positive	Paratyphoid A.
(2)	„ H.	„	"G"	15	2.3.12	27.2.12	15.2.12	6th	„	„
(3)	„ C.	„	"G"	15	2.3.12	28.2.12	16.2.12	6th, 7th, 16th	Sterile	Pyrexia. Clinically *B. paratyphosus* A.
(4)	„ Bo.	„	"D"	7	9.3.12	7.3.12	24.2.12	3rd	Positive	Paratyphoid A.
(5)	„ A.	„	"B"	2	12.3.12	8.3.12	25.2.12	6th	„	„
(6)	„ Ay.	„	"B"	2	16.3.12	12.3.12	29.2.12	6th	Sterile	Pyrexia (doubtful case).
(7)	„ Gs.	„	"D"	110	17.3.12	12.3.12	29.2.12	6th	Positive	Paratyphoid A.
(8)	„ T.	„	"D"	7	18.3.12	15.3.12	3.3.12	4th	„	„
(9)	„ Ld.	„	"E"	9	19.3.12	18.3.12	6.3.12	4th	Sterile	Pyrexia (doubtful case).
(10)	L.-C. S.	„	"B"	109	23.3.12	20.3.12	8.3.12	5th	„	„ „
(11)	„ Co.	„	"D"	7	24.3.12	19.3.12	7.3.12	7th	Positive	Paratyphoid A.
(12)	„ Cl.	„	"E"	8	24.3.12	21.3.12	9.3.12	5th	„	„
(13)	„ E.	„	"B"	2	27.3.12	25.3.12	13.3.12	3rd	Sterile	Pyrexia. Clinically *B. paratyphosus* A.
(14)	Pte. S.	„	"D"	7	28.3.12	22.3.12	10.3.12	7th	„	„ „
(15)	Pens. B.	—	—	—	28.3.12	22.3.12	10.3.12	7th	„	„ „
(16)	Pte. N.	E. Yorks.	"G"	14	29.3.12	27.3.12	15.3.12	4th	„	„ „
(17)	„ Ba.	„	"E"	8	30.3.12	25.3.12	13.3.12	7th	Positive	Paratyphoid A.
(18)	„ La.	„	"E"	108	12.4.12	6.4.12	25.3.12	7th	„	„

Clinically all the cases were of the same type, the chief symptoms being severe headache (frontal and occipital), general malaise, insomnia, constipation and slow pulse. In a few cases tonsillitis and an initial bronchitis occurred. The pulse-rate will be referred to later.

All the cases were bacteriologically diagnosed by blood culture, a subculture being sent to the Enteric Depot, Naini-Tal, for confirmation. Captain J. L. Wood, R.A.M.C., confirmed the diagnosis in each case. During this outbreak among the British troops blood cultures were examined from men suffering from fever in the native troops hospital, and the *B. typhosus* was isolated once and the *B. paratyphosus* " A " twice.

The garrison at Fyzabad consists of—

One battery Royal Field Artillery (28th Battery R.F.A.).

One ammunition column (8th Ammunition Column).

One battalion British Infantry (2nd East Yorkshire Regiment).

One regiment Indian Cavalry (4th Cavalry).

One regiment Indian Infantry (9th Bhopal Infantry).

It will be noticed that in the above table the East Yorkshire regiment was the only one affected, and that no case of enteric fever occurred during this time, although in 1910 this regiment had the second highest incidence for this disease in the whole of India. Ten to fifteen days is usually considered to be the incubation period of the disease. In the above table I have reckoned it as twelve days. In nearly every case the patients were able to indicate definitely the day on which they first felt ill, their symptoms being generally described as " a bad headache with a touch of fever "; and this date was invariably taken as the day of onset, and the date of disease when taking the blood culture was estimated from this. This is an important point, as one so often sees on charts the first day in hospital reckoned as the first day of the disease, which is obviously erroneous, the patient in nearly every instance having been ill for three or four days prior to admission to hospital. Blood cultures are frequently sent to the laboratory marked " Blood taken on seventh day of disease," when, as a matter of fact, it is the tenth, or even eleventh day, and therefore practically useless.

The following is extracted from the first report on the epidemic by Lieutenant-Colonel R. W. Wright, R.A.M.C., Senior Medical Officer, Fyzabad :—

" Column 8 of the table indicates an increase of infectivity about February 15 (Privates Br. to C.); an interval of seven days, followed by a period (February 24 to March 15) of fairly even

distribution of infection; then after an interval of eleven days Private La. became infected.

"Private R.'s illness commenced while in camp at Sultanpur, on February 9." (The regiment was in camp at Sultanpur from February 7 to 17). "He was transferred to the Station Hospital on February 12, i.e., he was infective from February 9 to 12.

"Private Br. may have been infected from Private R., and was himself infective from February 24 to 28. Privates Go., H. and C. may also (with a fifteen or sixteen day incubation) have derived infection from Private R.

"The four cases infected on February 24 to 29 may have been derived from Private Br. One infection on March 3 may have been derived from Privates Go., H. or C., and the cases March 6 to 10 from Privates Bo. or A. Those on March 13 and 15 from Privates Gs. and T.

"Private La. may have contracted the disease from Private Ba., who became infective on March 25.

"It is perhaps noteworthy that after Privates R. and Br. the chain of possible infection can be completed without including the cases diagnosed pyrexia, i.e., the links are formed by those in whose peripheral blood the *B. paratyphosus* was found. This theory is not, however, supported by the distribution by barrack rooms."

In investigating this outbreak a search was made for a possible "carrier," and thirteen men (whose histories were suspicious) were isolated in hospital. These included Privates M., G. and R. Private Br. was under treatment in hospital at the time and had given a negative blood culture. Five men who were known to have suffered from the disease the previous year were also isolated.

Each man was provided with a separate commode, not containing any antiseptic, and a sterile tube for urine. The urine and fæces of each man was examined, bacteriologically, daily for ten days with negative results.

Major Grattan, R.A.M.C., the Divisional Sanitary Officer, arrived on March 25, to make an investigation, and together we made the following Widal examinations:—

Ninety-two men, East Yorkshire regiment; 18 regimental dairy employees; 10 regimental soda-water factory employees; 15 regimental bakery employees; 20 regimental coffee-shop employees; 2 regimental canteen employees; 8 R.A.T.A. employees; 9 temperance hall employees; 1 barber; 3 refreshment room employees.

Among the 178 individuals so examined, the following reactions were obtained :—

One soda-water factory employee, *B. typhosus*, 1—20 ±,	*B. paratyphosus* A,	1—10 ±	
		1—20 ∓	
		1—40 –	
One coffee shop employee, *B. typhosus*, 1—20 –,	,, ,,	1—10 ∓	
		1—20 ±	
		1—40 ∓	

There is no evidence that either of these men had suffered from any form of illness lately. Both were isolated in the Cantonment Hospital and their excreta examined with negative results.

During the treatment in hospital a special study was made of the Widal reactions of the cases, an examination being made weekly, after the ninth day of the disease. The results were very variable, and as a means of distinguishing typhoid from paratyphoid fever were found unreliable. In inoculated men the typhoid agglutinins were often higher than the paratyphoid agglutinins throughout the disease. The paratyphoid agglutinins appeared to be highest about the twenty-second day.

Chart 1 illustrates a typical case.

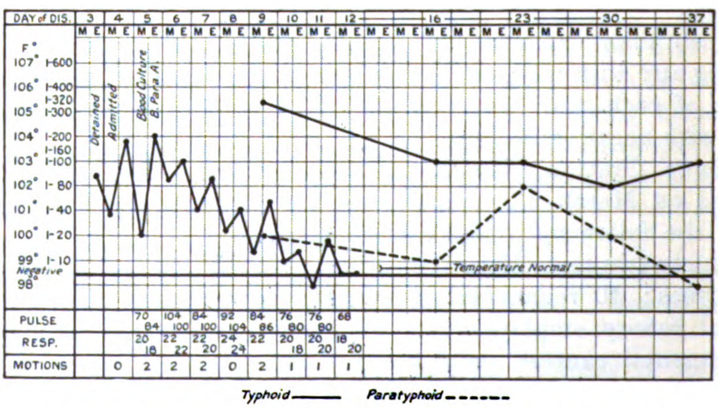

CHART 1.—To illustrate a typical case with agglutination results.

Chart 2 illustrates a case with exceptionally high agglutinins.

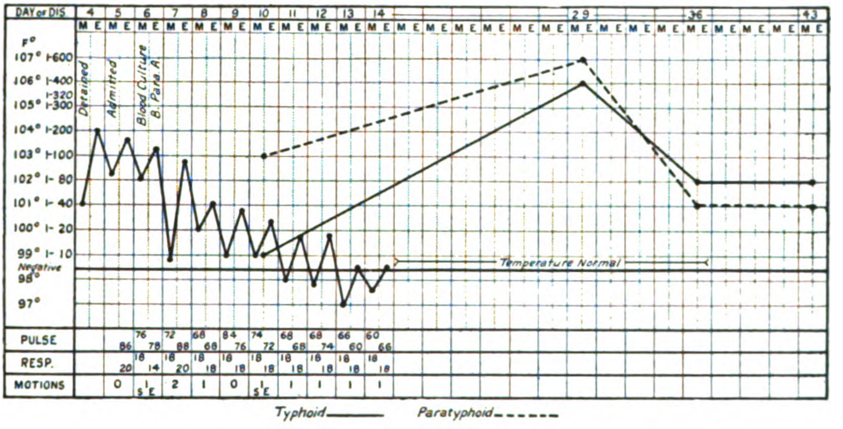

CHART 2.—To illustrate a typical case with high agglutination results.

Chart 3 illustrates a severe case complicated by phlebitis in both legs.

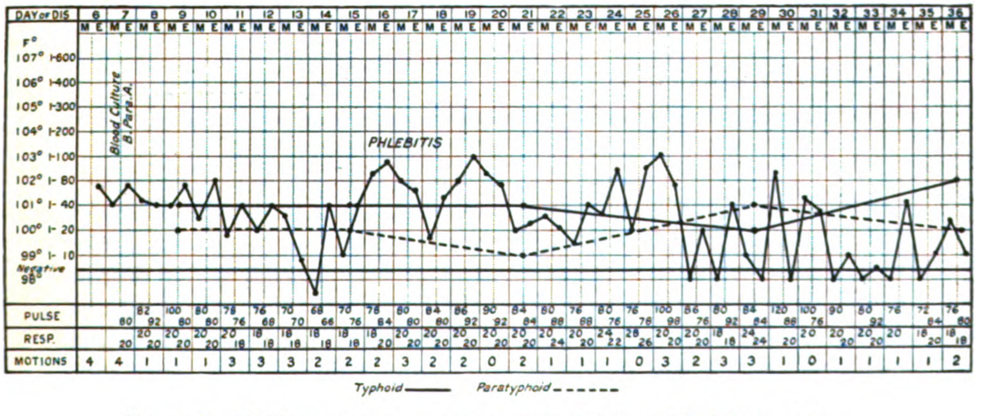

CHART 3.—To illustrate a severe case complicated by phlebitis in both legs. Agglutination results.

Charts 4 and 5 illustrate two ambulatory cases.

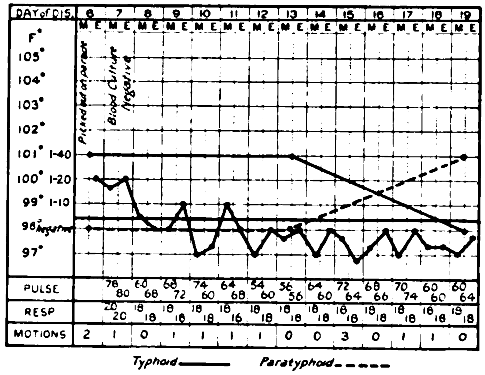

CHART 4.—To illustrate an ambulatory case (Gunner G.) which gave a negative blood culture, but from which the bacillus was isolated from the fæces on the twentieth day of disease. Agglutination results.

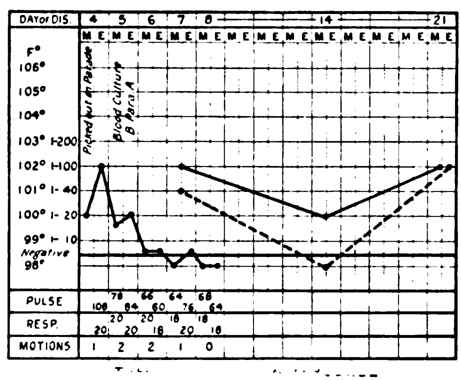

CHART 5.—To illustrate an ambulatory case with positive blood culture. Agglutination results.

Clinical Signs and Symptoms.—The severity of the infection varied considerably, but the general symptoms were as already indicated. With the exception of two cases which suffered from a relapse, and one case of phlebitis, there were no complications. No case suffered from cholecystitis, while of the five cases which occurred during the previous year, three suffered from this complication. A rash was only noticed in a few cases. For the first two or three days insomnia was the most distressing symptom, but when once the headache subsided this improved and the general

appearance of the patient was distinctly good, and by the end of the first week in hospital, i.e., by the tenth or eleventh day of the disease, he felt quite well. The average duration of fever was twelve days.

The Pulse-rate.—Grattan and Wood[1] state : "The pulse differs from that of enterica, it is more rapid and more in keeping with the temperature. A pulse of 112 is quite a common feature in contrast to the slower pulse of enterica, and is not so much an indication of a severe attack of the fever as would be the case in the more serious disease." Bainbridge[2] states : "In contrast with mild enteric fever the pulse is rapid and is quite often as much as 110; the frequency of the pulse in paratyphoid fever does not necessarily indicate that the attack is a severe one."

Fox,[3] describing cases of fever which occur in North China, and which he considers are probably paratyphoid fever, states : "The disease is characterized by the following signs and symptoms, the first five being invariably present in all cases : (1) Fever of a remittent type; (2) frontal headache lasting from two to three days; (3) constipation; (4) furred tongue; (5) slow pulse (comparatively speaking)." These symptoms in my opinion may be considered as the cardinal symptoms of paratyphoid fever.

A comparatively slow pulse-rate in paratyphoid fever has been my experience; so much so that I consider it a most valuable aid in diagnosing the disease from a clinical standpoint.

Major Grattan, R.A.M.C., in charge of the Enteric Depot, Naini-Tal, has kindly placed at my disposal the charts of cases of paratyphoid fever transferred from various stations in India, and after examining 100 charts I find that the average pulse-rate on the eighth day of disease—

When the evening temperature is between 100—102° F., equals 78.

When the evening temperature is between 102—104° F., equals 86.

The average highest pulse-rate, *during fever*, equals 91.

The average lowest pulse-rate, *during fever*, equals 66.

In only one case did the pulse-rate reach 120 at any period of the disease, and in two only, 112. The records examined were from fourteen different stations in India.

Treatment.—If the patient gave a history of constipation, and it was early in the disease, an initial dose of castor oil was given, but

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[1] Journal of the Royal Army Medical Corps, August, 1911.
[2] *Lancet*, March 16, 1912.
[3] Journal of the Royal Army Medical Corps, August, 1912.

if the patient was not admitted until after the fifth day of disease, enemata were administered. For the insomnia occasionally potassium bromide and chloral were prescribed for a couple of nights, but as a rule this was not necessary. Aspirin in small doses was sometimes useful in relieving the headache. No other drugs were employed. The only treatment required was careful dieting and enemata to regulate the bowels.

Diet.—For the first few days only *milk-whey*, made with sherry, was allowed, and afterwards, until the temperature became normal, only diluted milk. No other diet, except an egg-flip, was allowed until the temperature had been normal for ten days, when a custard was added, and after the temperature had been normal for fourteen days the diet was gradually increased. Any rise in temperature was considered an indication to diminish the diet. I consider both cases of relapse were due to too early feeding.

Convalescence.—Although the fever is a comparatively mild one it is astonishing how debilitated the patients become, and great care and discretion are necessary during convalescence. The diet should be carefully regulated and of the most nourishing kind. Jam is a most useful adjunct during this period, and in my opinion is not sufficiently often prescribed in debilitated conditions. Porridge and rice puddings, which the soldier is so fond of, should be avoided.

The cases were transferred to the Enteric Depot, Naini-Tal, a month or six weeks after their temperatures had been normal.

PART II.

What may be described as the second outbreak, although the two were undoubtedly intimately connected, began on May 1, for a description of which I cannot do better than give the report by Lieutenant-Colonel R. W. Wright, R.A.M.C., *in extenso* :—

"REPORT ON AN OUTBREAK OF PARATYPHOID 'A' AT FYZABAD. BY LIEUTENANT-COLONEL R. W. WRIGHT, R.A.M.C.

"On May 1 two patients were admitted from the 8th Ammunition Column, one of whom was clinically and the other bacteriologically found to be suffering from paratyphoid 'A' fever. These two cases proved to be the first of another outbreak of this disease in which nine cases occurred, all but one of these coming from one of the Artillery units. This distribution of the cases is a very striking feature of the outbreak.

"The following is a list of the cases in their order of admission:—

TABLE I.

Name	Corps	Barrack-room	Admitted to hospital	Illness commenced	Diagnosis	Remarks
Cpl. M.	A. Column	1	1.5.12	22.4.12	Pyrexia	11 days' fever, blood culture 9th and 16th days negative.
Gr. Wh.	,,	1	1.5.12	27.4.12	Para. A	Blood culture 12th day +
Dr. L.	28th Battery	1	2.5.12	28.4.12	,,	,, ,, 22nd ,, (relapse) +
Pte. By.	E. Yorks.	8	5.5.12	30.4.12	,,	,, ,, 7th ,, +
Gr. Gi.	A. Column	1	7.5.12	4.5.12	,,	,, ,, 5th ,, +
,, Go.	,,	1	8.5.12	14.4.12	,,	Ill in barracks for a week, 10 days.*
,, Bl.	28th Battery	2	21.5.12	15.5.12	,,	Blood culture, 8th day +
,, C.	,,	2	26.5.12	23.5.12	,,	,, ,, 4th ,, +
,, Wa.	,,	2	26.5.12	23.5.12	,,	,, ,, 4th ,, +

* Well, then ill again. Admitted seventh day of relapse, *B. paratyphosus* "A" from fæces, May 22, 1912.

"Taking each case and allowing twelve days as an average incubation period, we get the list *in order of dates of infection* as in Table II.

"This table indicates that the Ammunition Column became infected at the beginning of April. The question appears to be: What change in the environment of the column took place at this date which might account for the unit becoming suddenly infected?

TABLE II.

Corps	Name	Date of infection	Date of admission
A. Column ..	Go.	April 2	May 8
,,	M.	,, 10	,, 1
,,	Wh.	,, 15	,, 1
28th Battery	L.	,, 16	,, 2
E. Yorks ..	By.	,, 18	,, 5
A. Column..	Gi.	,, 22	,, 7
28th Battery	Bl.	May 3	,, 21
,,	C.	,, 11	,, 26
,,	Wa.	,, 11	,, 26

"Up to March 31 the column was accommodated under canvas, there being no available barrack-room, and it is noteworthy that their (separate) conservancy arrangements were not altogether satisfactory, and that flies simply swarmed in the tents and on the men's food. But in spite of this there was no paratyphoid fever or pyrexia in the unit. At the end of March No. 1 barrack-room (see place with first report) was vacated by the East Yorkshire regiment and handed over to the column, which occupied it on April 1. The connexion between this date and the date of infection,

together with consideration of the previous immunity of the unit, appears to be more than fortuitous.

"In the outbreak among the East Yorkshire regiment no case was admitted from No. 1 barrack-room. When the column occupied this room they made use of a cook-house previously not used by the Infantry; the washhouse, urinal, and latrine were those used by their predecessors; they retained their own coffee-shop and refreshment-room.

"The washhouse and urinals were seldom used by any except the men of No. 1 barrack-room (previously not infected) but the latrine was used by men of several barrack-rooms, including No. 2, from which three cases were admitted in the first outbreak. These facts appear to point to the latrine near No. 1 barrack-room as the source from which the ammunition column became infected. While investigating this second outbreak it was brought to my notice that the men complained of bugs (*cimex*) in the latrines, and it immediately struck me that these insects might be the medium of carrying infection, and the officer in charge of the brigade laboratory was instructed to examine bugs from the suspected latrine. Unfortunately, some delay occurred, and the bugs in the suspected latrine were destroyed by kerosene before any were obtained for examination. Some were taken from other latrines, but no growth resembling *B. paratyphosus* 'A' was recovered from them.

"The table shows that Gunner Go. (who was apparently the first man of the column infected) was not admitted to hospital until the seventh day of a relapse; this man was probably instrumental in spreading the disease, as he did not come to hospital until May 8, though he was infected on April 2 and became ill on April 14. As to the infection of the 28th Battery, the guard-room latrine, which was used by both the Ammunition Column and the Battery, appears to have been the most likely place for this to have occurred, as bugs were found in this latrine, but were reported as being absent from the Battery latrines. Vigorous attempts were made to destroy bugs in all the latrines, and up to the time of writing only one sporadic case of paratyphoid 'A' fever has occurred since the last of those given in the tables—a man of the East Yorkshire regiment admitted to hospital on July 9.

"This second outbreak seems to emphasize the necessity for segregation of possible carriers and the frequent disinfection of latrines. The best method of destroying the bugs (*Cimex lectularius*) is under investigation. I may add that the date of

destruction of the bugs in the latrine near No. 1 barrack-room was approximately May 3 and 4, and that no case of infection among the column occurred after that date (Table II.)."

The importance of the ambulatory type of fever is well exemplified by two of these cases (see charts 4 and 5).

The case of Gunner Go. is particularly interesting. When the outbreak first occurred I inspected the men of the 8th Ammunition Column daily, and at one of my inspections noticed that this man was not looking well. He gave the following history. About seventeen days previously he had been feeling ill in barracks for about a week, but not sufficiently ill to report sick. He was then quite well for ten days, but again had been feeling out of sorts for several days, complaining chiefly of headache and loss of appetite. He was immediately sent to hospital and his temperature was found to be 100° F. He was detained that day and admitted on the following day, when a blood culture was made and proved to be sterile. His excreta were examined daily, and on May 22, fourteen days after admission to hospital, I isolated *B. paratyphosus* "A" from his fæces (*vide* chart 4).

There is no doubt but that he was suffering from a relapse when picked out on parade, and would not have reported sick. Fourteen days later he was passing bacilli in his fæces and so was a temporary "carrier" of the disease.

The other ambulatory case was similarly picked out on parade and sent to hospital. A blood culture in this case proved positive (*vide* chart 5).

Blood cultures should be made as early as possible in the disease, as a rule not later than the fifth day, and during an epidemic on the first, or at latest, the second day in hospital. It is also important that men reporting sick with "fever" should be admitted direct to hospital and not detained for a day or two. The routine method adopted at Fyzabad was to take a blood film immediately, and if no parasites were found the patient's arm was prepared by painting the skin at the bend of the elbow with tincture of iodine. A sterile dressing was adjusted and a blood culture taken that evening or the following morning, the skin being again painted with iodine prior to taking the blood.

Five c.c. of blood should be drawn from the vein and injected into a bottle of sterile ox bile, which is incubated for twenty-four hours and then plated.

It was most unfortunate that only one experiment was made

with the bugs from a latrine. This was due to the fact that before I heard of their existence the medical officer in charge of the regiment had taken such energetic action for their destruction that they had all been destroyed in the latrines under suspicion.

From a latrine in the Infantry lines I obtained ten bugs. These were washed in sterile saline and a loop from the washings plated on a Conradi plate. The bugs were then mashed up in fresh sterile saline and another plate made. No organisms of the typhoid group were recovered. I think it would be well worth while carrying on research in this direction.

I am very much indebted to Lieutenant-Colonel Wright for much sympathetic help during the outbreaks, also for permission to use his reports.

My thanks are also due to Surgeon-General Anderson for permission to use reports, and to Major Grattan and Captain Wood for much assistance.

Clinical and other Notes.

ONE HUNDRED AND FIFTY CASES OF SYPHILIS TREATED WITH SALVARSAN DURING THE PAST TWO YEARS.

By Captain E. G. FFRENCH.
Royal Army Medical Corps.

On my arrival in India in October, 1910, I commenced the treatment of syphilis with salvarsan, and employed the intramuscular method for the first seventy-five cases, the remainder have been treated intravenously. As I was only able, through the kindness of Mr. McDonagh, to procure a few tubes before leaving England, the first cases treated were specially selected ones of so-called malignant syphilis. The results were most gratifying, and led me to use salvarsan more extensively in all forms of syphilis when I was able to purchase the drug. At first I employed Wechselmann's method, but soon gave it up for that of Dutrot. Only one case of the series of seventy-five showed necrosis of tissue at the site of injection—this was not severe, and soon healed, after scraping the part with a sharp spoon. About six cases developed, at the site of injection, swellings the size of a small hen's egg, but these subsided within three months, and did not inconvenience the patients in any way.

The results by the intramuscular method were very satisfactory, and for some time I was reluctant to give it up for the intravenous method. The only cases which complained of much pain for two or three days afterwards were those who were in the habit of consuming a good deal of alcohol daily; the others thought very little of it, especially when Dutrot's method of using only a small quantity of solution was employed. During the past year I have employed the intravenous method almost exclusively, and the results have been equally good, the disappearance of symptoms being somewhat quicker. I have tried both methods extensively in all sorts of cases, having given more than four hundred injections, and I am of opinion that the intravenous is the better method of the two. I have been able to keep nearly all my cases under observation from the commencement of their treatment till the present time.

A large number of my cases were treated at the Station Hospital, Ahmednagar, where I was stationed on my arrival in India. In the laboratory there we employed Wassermann's reaction in nearly all the cases—the test being made once every two months in each case. It was our experience that it took at least a month before a negative reaction appeared after a dose of salvarsan, although in three or four cases we got a negative result within a week of the injection, and the cases remained negative and showed no symptoms afterwards. These cases

were primary, and there is little doubt that the disease was eradicated, as they have been under observation for eighteen months, and Wassermann's test has been carried out from time to time. Of the one hundred and fifty cases treated, thirty-three were in the primary stage, sixty-five in the secondary stage, and fifty-two in the tertiary stage. During the first year the primary cases were given salvarsan alone, to see if this drug would effect a cure. In about 70 per cent of the cases slight secondaries, e.g., congestion of the fauces, mucous patches on the tongue, &c., made their appearance sooner or later. None of the cases developed a roseolar rash or a papular syphilide—this demonstrated to me the superiority of salvarsan, as compared with mercury, in preventing serious secondary lesions. During the past year I have combined mercury with salvarsan in all primary cases at the start, and the results have been most satisfactory. My routine is to give a dose of 0·6 grm. salvarsan as soon as the diagnosis has been confirmed by Wassermann's test, and to commence weekly injections of mercurial cream (gr. 1) at the end of the first week. A second dose of 0·6 grm. salvarsan is given at the end of the first month. The mercurial injections are carried on for twelve weeks. Past experience has taught one that a single dose of salvarsan with twelve mercurial injections would not produce consecutive negative Wassermann's reaction, and I believe that at least two doses should be given—cases so treated have shown no secondary symptoms, and the résults of their Wassermann test, made at intervals of two months, have been negative on several occasions.

Of the sixty-five cases treated during the secondary stage, nearly all had had some mercurial treatment before being injected with salvarsan. A good many had undergone at least one year's mercurial intramuscular injections. These cases gave a positive Wassermann's reaction before the salvarsan was given, but the reaction became negative a month or two afterwards, and has remained negative without any clinical symptoms since. There were a few exceptions, however, in which it was necessary to give a second or third dose of salvarsan to clear up symptoms and produce a negative reaction.

Of the fifty cases treated in the tertiary stage nearly all had undergone mercurial treatment in various degrees at some period of their disease In the majority of the cases two doses of salvarsan were sufficient to clear up their symptoms and produce a negative blood test. Some of the cases had very severe lesions, such as perforation of the hard and soft palate and ulcerating gummata involving joints. They made remarkable progress after the first dose, and it was only necessary to give a second dose to complete the healing of the parts. The cases that persisted in giving a positive Wassermann at the end of three months have been treated with mercurial intramuscular injections with the desired result.

I have never experienced any untoward results from salvarsan such as have been recorded by some Continental observers—indeed, a few cases

exhibited signs of auditory nerve inflammation and optic neuritis before being injected with salvarsan, and became perfectly well afterwards. The patient should always be carefully examined beforehand, and be made to understand that he is to lead a very quiet life for at least a week after the injection. Salvarsan is a wonderful drug in clearing up symptoms, but experience has taught one that salvarsan alone will not effect a cure in the great majority of cases; when combined with mercury we may expect a permanent cure.

Notes on Some Cases.

Weight charts are kept for all patients treated in the military hospital.

Case 1.—*Hemiplegia Successfully Treated.*—A. B., aged 47, acquired a sore three years ago, but did not consult a medical man, and as the sore healed rapidly under local treatment, he concluded that it was not a syphilitic one. According to his statement he kept quite free from any symptoms in the interval. However, one day, on alighting from a railway carriage, he fell down unconscious. On his regaining consciousness soon afterwards it was noticed that he was suffering from all the typical symptoms of hemiplegia on the right side. He was treated with pot. iod. and liq. hyd. perchlor. for a fortnight, as he gave a history of a sore, and syphilis was suspected. He improved somewhat under the treatment, but dragged his right leg in attempting to walk, and was not able to grip anything with his right hand. His speech was also very much affected, and he was not able to whistle. During that time his blood was examined on two occasions, and gave a strong positive Wassermann reaction. He was told that his trouble was due to syphilis, and he expressed a desire to be treated with salvarsan. I was reluctant at first to try the remedy in such a case, but the patient persisted after being warned of the risks. He was accordingly given 0·5 grm. salvarsan intramuscularly, and he stood the injection well. Improvement was noticed in his condition on the following day, and he improved day by day until he was discharged at the end of three weeks. During his stay in hospital, the pot. iod. and liq. hyd. perchlor. mixture was kept up, and he continued taking it with intervals for four months afterwards. On discharge from hospital he was almost well again. He had regained a firm hand grip, he was able to smile and whistle without showing any sign of facial paralysis. The power in his lower limb had markedly improved, and he stated that he felt remarkably well. He resumed light duty at the end of another month, and was able to ride quietly. His blood showed a weak positive Wassermann at the end of the first month, but was negative at the end of the second month. With the exception of slight weakness in the lower limb, he was as well as ever. He went to England on long leave soon afterwards. The result surprised every one who saw the case, and one is inclined to believe that salvarsan is not contraindicated in every case of hemiplegia.

Case 2.—Private J. S. was transferred from another station suffering from an ugly looking phagedenic ulcer of the glans penis. His blood was examined and gave a strong positive Wassermann reaction. He was given 0·6 grm. salvarsan soon after admission, and the ulcer commenced to heal at once. At the end of a fortnight it had completely healed. At the end of the first month he gave a weak positive reaction. At the end of the second and fourth months the reaction was negative. He was given a course of mercurial injections afterwards. His weight chart showed that he gained 15 lb. in two months.

Case 3.—Private J. J. was admitted to hospital suffering from a typical Hunterian chancre. His blood was examined and gave a positive Wassermann reaction. A few days after admission 0·6 grm. salvarsan was injected and the chancre had completely disappeared at the end of the week. At the end of the first month the reaction was still positive and continued so for two months afterwards. About this time he complained of severe headache and his weight had gone down by several pounds. He was given a second injection of 0·6 grm.; the headache disappeared at once and his weight started to go up. His blood was negative on three subsequent occasions. He was given a course of mercurial injections as well; he gained 10 lb. in weight.

Case 4.—Private C. L. was admitted to hospital suffering from a copper-coloured rash all over his body and extremities. This came on two days before admission. He was also suffering from painful enlarged cervical and inguinal glands, as well as marked inflammation of the fauces and ulcers on the tongue and cheeks. He had treated the sore himself with lotio nigra obtained in the Bazaar, but had not had any other treatment. The history was that he contracted the sore two months ago in the Bazaar. On admission a specimen of his blood gave a positive Wassermann reaction. A few days afterwards he was injected with 0·6 grm. salvarsan, and his improvement was very rapid. The ulcers in the mouth and the inflammation of the fauces disappeared in three days; the rash over the body and extremities disappeared completely at the end of a fortnight. I should have mentioned that the swollen painful glands disappeared in about forty-eight hours. Two months afterwards his blood was examined and found negative, but the following month it was weakly positive. He was put on a course of mercurial injections (twelve) and at the completion he gave a negative reaction which remained so on several subsequent occasions. He gained 16 lb. in weight.

Case 5.—Private P. W. was admitted to hospital suffering from two small ulcers on the glans penis. He gave a history of sexual intercourse a month before the sores appeared. His blood gave a positive Wassermann. Soon after his admission he began to suffer from alopecia and a roseolar rash made its appearance over his body. He was injected with 0·6 grm. salvarsan and all his symptoms cleared up within ten days.

His blood was still positive at the end of the first month, but became negative two months after and has remained so. He had a course of twelve mercurial injections and gained 9 lb. in weight.

Case 6.—Private H. E. This patient was transferred from another station hospital to undergo salvarsan treatment, as he resisted mercurial treatment in various forms, and his condition was getting worse. On admission I found him in a very emaciated condition and he was scarcely able to walk. He had a cachectic appearance and large nodes were present on both insteps and on the right middle finger, he was also suffering from a whitlow on the left index finger. There was marked periostitis of both tibiæ, very painful to the touch, and both elbow joints were swollen and the movements restricted. He had a large perforating ulcer of the hard palate about the size of a shilling, and his throat was very congested. His weight was 99 lb. and he stated that since his illness began he had lost a little over a stone. On examination, his pulse was weak and irregular and on palpation a thrill was felt over the apex. Auscultation revealed a presystolic murmur; the other organs were normal and the urine was free from albumin. On account of the very weak condition of the patient, I decided to give mercury and pot. iod. another trial, but he became worse in spite of various forms of mercurial treatment being used. Up to this time he had had mercurial treatment (injections of cream mainly) for nearly a year. As there was no improvement and he was very anxious to have salvarsan, he was injected at the end of January with 0·6 grm. salvarsan, and from that date all symptoms of the disease showed rapid improvement. His weight went up with a bound and at the end of a fortnight he had gained 10 lb. A specimen of his blood was examined a month afterwards and gave a positive reaction. On March 9 he was given a second injection of 0·6 grm. salvarsan. His condition rapidly improved and a month afterwards he looked and felt quite well, and showed no clinical signs of the disease.

The perforation of the palate had completely healed and this enabled him to swallow all his food without inconvenience. Two months after the second injection his blood gave a negative Wassermann, and he had gained 24 lb. in weight. He was able to rejoin his regiment shortly afterwards, and has kept in good health ever since. This was one of the few cases that I have come across which was really resistant to all forms of mercurial treatment, and had it not been for salvarsan I am convinced he would have lost his life.

Case 7.—J. G. was admitted to hospital suffering from a large perforation of the soft palate about the size of a florin. He acquired syphilis ten years ago, and only received six weeks' mercurial pill treatment. His medical history sheet did not show any readmissions for syphilis, and according to his own statement he had kept in excellent health until the ulceration of the palate commenced a short time before his admission. He was put on pot. iod. and liq. hyd. perchlor.,

but instead of getting better the ulcer grew larger. Other forms of mercury were tried without benefit, and it was decided to try salvarsan. He was injected with 0·5 grm. in November, 1910, and on the day following an improvement was noticed in the condition of the ulcer. His progress was very rapid, and at the end of three weeks the ulcer had completely healed. At the end of a month he had gained 12 lb. in weight. On his discharge from hospital, some two months after the injection, he had gained 15 lb. in weight, and was looking remarkably well. He had regained his voice, and was able to drill his company. His weight steadily increased, and at the end of the following May he had gained 2 st. in weight. His blood has been examined on several occasions since, and has remained negative.

Case 8.—Private A. R. was transferred from another Station Hospital suffering from extensive ulceration of the gums and throat. There was marked periostitis of both tibiæ, and he suffered from severe nocturnal pains. The nasal bone on the left side was necrosed, and there was a foul smelling discharge from the left nostril. He was greatly emaciated, and weighed only 132 lb., having lost 21 lb. since the disease was contracted. Before coming under my care he was treated with mercurial inunction, pills, and cream, but proved resistant, and he was rapidly going downhill. On December 6, 1910, a few days after his admission, 0·5 grm. salvarsan was injected, and on the following day improvement was noticed. The tibial pains disappeared after the second night.

At the end of the first month he had gained 23 lb. in weight. A small piece of necrosed bone in the nose still kept up the discharge. A second dose of salvarsan was injected seven weeks after the first. A week afterwards the necrosed bone came away, and the discharge ceased at once. His weight went up again, and on his discharge from hospital at the end of February he had gained 24 lb. His blood before discharge was negative. I was not able to do any more blood tests.

Case 9.—Private J. R. was admitted to hospital suffering from a gumma of the right testicle; the hard swelling which was situated on the posterior aspect of the testicle was the size of a sour lime and had a sinus communicating with it. He had had two courses of mercurial injections before the appearance of the swelling. He was put on pot. iod. and mercury, but the discharge from the sinus was still copious at the end of a fortnight. He was then injected with 0·6 grm. salvarsan on March 23, 1911, and within a week the swelling was softer and smaller and the discharge was appreciably less. There was also psoriasis on the front and back of the chest on admission, but this disappeared completely in ten days after the injection. The gumma became smaller as time went on and at the end of the first month it was the size of a hazel nut and the discharge was scanty. He was given a second

injection of salvarsan on April 24. At the end of another month the gumma had completely healed and the sinus had closed.

His blood was tested before discharge, but was still positive. A month after his discharge the blood was negative on being tested. He was allowed to continue his courses of mercury and has kept free from symptoms ever since.

I have also used salvarsan in two cases of malignant malaria with success. Both of these cases were frequently in hospital with crescents in their blood and marked cachectic appearance.

It was decided to try salvarsan and 0·6 grm. was injected into each patient. In both of them the blood showed crescents immediately before the injection, but they disappeared on the following day and the patients have had no recurrence of malaria. One case was injected eighteen months ago and the other during the spring of this year. I have not had any other cases of malignant malaria under my care recently, but in future I shall always feel justified in treating such cases with salvarsan.

RESULT OF THE COMBINED METHOD OF TREATMENT ON GONORRHŒA.

By Captain A. C. OSBURN.
Royal Army Medical Corps.

The following results of treating gonorrhœa with vaccine combined with various other forms of treatment may interest some of the readers of the Journal.

The line of treatment adopted for the first ten days was the usual one, viz., solutions of potassium permanganate and protargol for irrigations, this was followed by two or more injections (200 millions) of stock gonococcal vaccine at short intervals, while irrigation with a quadruple sulphate solution containing the sulphates of copper, iron, alum, and zinc was substituted for the protargol and in obstinate cases injections of solution of iodine or emulsions of cinnamon oil.

The results have been very satisfactory both from the point of view of shortening the period under treatment and the absence of relapses.

Taking the last 100 consecutive cases of gonorrhœa treated it was found that in sixty-two consecutive cases treated in the old way (with irrigation of Condy and protargol) the average period in hospital was no less than fifty-four days, whilst in the consecutive thirty-eight cases which had the combined treatment the average period in hospital has been only twenty-six and a half days, and what is even more important, there has not been any re-admission or relapse in these latter cases.

The only drugs given by the mouth have been methylene blue and urotropin.

I am inclined to think that the vaccine is more efficacious if given just after the acute stage is passed, and before the typical "gleety discharge" has become established.

A CASE OF *BACILLUS COLI* INFECTION OF THE KIDNEYS TREATED BY ANTI-COLI SERUM.

By Captain S. E. LEWIS.
Royal Army Medical Corps.

The following notes may be interesting, as they show such a remarkable response to treatment when the diagnosis, which I regret to say was a little late, was made.

Mrs. S. was admitted to the Military Families Hospital, Devonport, on December 27, 1912, for her confinement.

The patient was well known to me, as she had been in hospital some months before suffering from double aortic disease.

On examination all the signs and symptoms of a fairly compensated double aortic lesion were very evident; the patient complained of pain over the lumbar region, which she stated had been present for the past month and had varied in intensity. Not very much notice was however taken of this pain as the patient was in labour, the presentation being a L.O.A. Examination of the urine showed that it was very acid, Sp. Gr. 1028, and it contained a trace of albumin.

December 28.—The baby was born to-day without any difficulty, but there was more loss of blood than is usual, the pulse being as a result somewhat rapid this evening, 104. Temperature 98.

December 31.—The patient's pulse, temperature, and general condition showed no change until this evening, when she complained of a headache, pain over the lumbar region, and the temperature rose to 100, pulse 98.

Examination showed the lochia to be normal, the uterus involuting well, and she was quite free from pain on pressure over the uterine area.

The patient had an abundance of milk.

Treatment.—She was ordered a vaginal douche (Lysol ʒi to the pint), a mixture containing liquid extract of ergot and quinine, also calomel gr. iii at 10 p.m. to be followed by mist. alba ʒi in the morning at 7 a.m., and the head of the bed was raised to promote drainage.

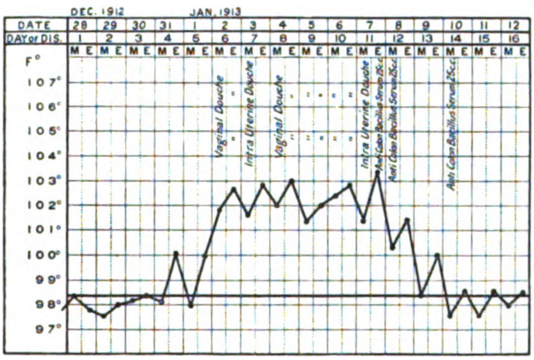
This treatment was ordered as I thought the case to be a mild one of sapræmia, the most usual cause for the above symptoms, and fully expected the temperature and pulse to fall to normal in the course of a day or two.

January 2.—The patient complained of frequent and painful micturition, some headache, and that she had slept little during the night.

Temperature in the morning 101·6, pulse 101. Examination of the urine showed it to be still very acid and to contain a trace of albumin.

The patient did not look very ill, the uterus and lochia were normal, there had been no rigors, no vomiting or diarrhœa and no rash of any kind, but still the case was a very disturbing one. Vaginal douches, morning and evening, had been carried out, the ergot and quinine mixture repeated and the patient isolated.

January 3.—Temperature to-day 101·6, pulse 112, and she slept after morphia gr. $\frac{1}{6}$ and liquor strychninæ ♏iij injected hypodermically. She complained to-day of more acute pain over the kidneys; they were tender to the touch, and there was also slight incontinence as well as frequency of micturition.



As I still thought the case one of sapræmia, an intra-uterine douche was given this morning, but only a few shreds came away. It was difficult to explain the bladder symptoms. The patient did not look as if she had septicæmia, and there was still an abundance of milk.

January 7.—The temperature has fallen slightly since the intra-uterine douche; there has been little change otherwise except that the pulse is now quicker, 120.

The intra-uterine douche was repeated this morning and arrangements made to curette the patient to-morrow, and to take a swab from the uterus, although an anæsthetic seemed dangerous in view of the patient's marked cardiac lesion.

On visiting the patient this evening she complained of some headache, great thirst, and acute pain over the right kidney, which was very tender to the touch; incontinence, frequency of micturition and dysuria were marked. The temperature was 103·6, pulse 120, tongue coated and dry, breath foul.

A catheter specimen of the urine was obtained and sent to Major Packer, R.A.M.C., for examination.

As the patient's condition suggested the existence of a bacilluria it was decided to try an injection of anti-coli serum; 25 c.c. (Burroughs and Wellcome's) were injected subcutaneously and the patient ordered calcium lactate gr. 10 t.i.d., to counteract the joint pains, irritating rashes, &c., so liable to occur after serum injections.

January 8.—The patient slept well last night, the pain is now much less, the temperature this morning has fallen to 100·4 and the pulse to 96.

After this marked improvement it was decided not to curette the uterus, but to repeat the injection of 25 c.c. of anti-coli serum.

January 9.—Improvement still more marked. The temperature and pulse were normal. The patient was practically free from pain, and stated that she felt quite well. Her tongue was clean and moist, there was no frequency of micturition or incontinence, and these are important symptoms in cases of *Bacillus coli* infection of the kidneys.

Major Packer informed me to-day that the specimen of urine forwarded to him gave a pure culture of *B. coli*.

January 10.—There was a slight rise of temperature last night to 100, 25 c.c. of anti-coli serum injected this morning.

January 14.—The patient has made a steady recovery since the last note and was allowed up to-day.

January 20.—The patient was discharged from hospital.

Lecture.

MAP READING.[1]

By Captain M. FISHER.
West Yorkshire Regiment.

The subject of map reading is really a very interesting one, and the information about the country and roads that a highly efficient map-reader can obtain from a map seems, to the uninitiated, really extraordinary. The subject is, however, not so difficult to master as it appears at first. Like a lot of other things, it is quite easy to do when you know how to do it. The way to success is a thorough knowledge of what each line or sign drawn on a map means and then continual practice out in the country constantly comparing the country with the map. It is not proposed, nor indeed is it in the scope of this lecture, to go very deeply into the subject, but only to touch on so much of it as will enable you,

[1] Delivered at York to the R.A.M.C. officers in the Northern Command.

with the use of a fairly good map, to find your way about and fix your position on it quickly and with a certain amount of accuracy.

The manual on this subject lays down that "An officer or N.C.O. may be said to be proficient in map reading when on examination a map conveys to him a clear impression of the ground features as represented by contours or shading, and of all the natural or artificial features exhibited on the map. Further, he should be able to identify his own position on the ground quickly and to recognize all visible objects marked on the map." As regards the artificial features shown on a map, these generally speak for themselves; for instance, woods, roads, railways, field fences, &c., are fairly obvious. Roads are shown in various maps; taking the 1-in. Ordnance map as an example, on the bottom of the map will be found an explanation of all the signs used on the map. I want you to particularly notice the difference between an embankment and a cutting, as it is not quite obvious unless looked at carefully.

The outside edges of a cutting are all joined by a line, while in the case of an embankment they are not so joined. Also please note carefully the difference between a footpath and the boundary of a county, as they are very alike; and the consequence of mistaking the one for the other might quite possibly lead to one getting temporarily lost. The next things I want you to look at are the contours, and here I think we run into the most difficult, or very nearly the most difficult, part of map reading. The manual of field sketching lays down that a contour may be defined as: The representation of an imaginary line running along the surface of the ground at the same height above mean sea-level throughout its entire length. To start off with, one must firmly fix in one's mind—(1) That a contour cannot go up or down hill; (2) that it cannot leave the ground.

One must bear in mind that the closer together contours are on a map the steeper will be the slope on the ground; and, vice versa, the farther contours are apart on the map the gentler will be the slope on the ground. From this it follows that from a map one can tell fairly accurately whether certain roads are too steep to get wagons, &c., up. Of course, I do not mean to say that one could judge the slope of a road accurately from a map; only this, that if in moving ambulance wagons there were a choice of several roads, one could easily tell if any one of these were quite impossible and not worth reconnoitring on account of the slope, but you will quite understand that although a road were quite passable as regards slope other reasons might render it quite impossible to get wagons over it, e.g., the condition of the road surface. So that, however good one may become in time at reading a map, one must never regard it as an efficient substitute for going on to the ground and looking at it. I said just now that one could find out the slope of a road from the contours of a map.

It is done in the following way. It has been ascertained that to rise one foot at a slope of 1 degree it is necessary to move over a horizontal

distance of 19·1 yards approximately — this distance varies inversely with the slope—e.g., to rise 1 ft. at a 2-degree slope it is necessary to move $\frac{19{\cdot}1 \text{ yds.}}{2}$ horizontally. It varies directly as the height, e.g., to rise 2 ft. at a 1-degree slope one must move horizontally over 2 × 19·1 yards. Thus we arrive at the following formula:—

$$\text{H. E.} = \frac{19{\cdot}1 \times \text{V. I.}}{\text{D}}$$

Where H. E. = Horizontal equivalent.
V. I. = The vertical interval.
D. = The degree of slope.

To find the degree of slope along the road, measure the distance between two adjacent contours along the road—this gives H.E. (in yards). Note the difference in level between the two contours—this gives V.I. (in feet).

Then if H. E. = 500 yards and V. I. = 50 feet.

$$500 = \frac{20 \times 50}{\text{D}}$$

$$500 \text{ D.} = 1{,}000$$

$$\text{D.} = 2 \text{ degrees}$$

N.B.—For practical purposes 20 = 19·1 in this formula.

To express degrees of slope as a fraction, as is usual on roads, railways, &c., divide the degrees of slope by 60. In the above the slope as a fraction $= \frac{2}{60} = \frac{1}{30}$ = one in thirty.

Now, having said something about contours, I must mention that contours are not the only methods of showing the shape of the ground on the map. These are: (i) Shading; (ii) by means of the layer system—i.e., the various heights are shown in different colours; (iii) by what are called spot levels—that is, the heights of various points are marked all over the map. This last is seldom used by itself, but generally combined with one or other of the preceding methods, and in addition (i) and (ii) have often got contours as well. The best method of all is undoubtedly to show the shape of the ground by contouring. Contours do not obscure and are easily copied in the field, and show the ground features as clearly as it is possible to do so on a map. They, however, take a long time and much trouble to do, and therefore are expensive, which is probably why the best maps only are contoured. Probably you may at some time be given nothing better than a rough field sketch to work with. In that case, of course, one does not expect to find accurate contours, but the slope of the ground is sure to be shown somehow, and this will generally be done by means of what are called approximate contours or form lines, and these should be regarded as referring much more to the slope and general shape of the ground than to the actual height.

In a shaded map, on the other hand, there is scarcely anything definite as regards height or slopes, except the spot levels which are generally used with this class of map. There is this to note, however:

On a shaded map the lightness or heaviness of the shading does not mean great or less *height;* it means great or gentle slopes.

I think that finishes what I have got to say about the signs to be found on a map.

Now as to using the map on the ground. First look at the scale, which is the key to all the distances. This will always be somewhere on the map, and will generally be found expressed in three ways:—

(1) The scale will be drawn. It may not be drawn, however, to read the units we want—e.g., it may read miles and furlongs, and we may want hundreds of yards, or it may be in kilometres, and we want miles, &c.

Example.—(i) English map R.F. $\frac{1}{63360}$. Wanted a scale to read hundreds of yards.

Take, say, 8,000 yards.

G.	P.
1 inch	$\frac{1}{63360}$ inch
8,000 yds.	$\frac{8{,}000 \times 36}{63360}$ inches
	63360
	1056
	176
8,000 yds. = 4·54 inches	176)800(4·54
	704
	·960
	880
	·800

(2) The scale is shown as a fraction—e.g., $\frac{1}{63360}$, $\frac{1}{100000}$, &c. This means that one unit on the map represents 63,360 units or 100,000 units on the ground. From this fraction can be worked out any scale one may require.

Example.—(ii) English map R.F. $\frac{1}{63360}$. Wanted a scale of kilometres. (1 kilometre = 1,094 yards nearly.)

1 inch on the ground .. = $\frac{1}{63360}$ inch
1 yard .. .. .. = $\frac{1}{1760}$
1,094 yards or 1 kilometre .. = $\frac{1094}{1760}$

$$\text{Therefore 8 kilometres} = \frac{8 \times \overset{547}{1094}}{\underset{\underset{110}{220}}{1760}} = \frac{547}{110}$$

110)547(4·97
440
1070
990
·800

4·97 inches = 8 kilometres.

(3) The scale is written on the map—e.g., 6″ = 1 mile, 1″ = 1 mile, &c. This last method is very useful for field work. With practice one soon gets into the habit of estimating quite accurately what an inch looks like on a map, and by this means the map soon conveys definite distances to the mind. It is perhaps useful to remember that the humble halfpenny is exactly 1 in. in diameter. The next thing to look at on a map is what is called the V.I. of the map—i.e., the vertical interval between any two contours; having found this, the heights and slopes become intelligible. This is sometimes marked at the foot of a map in this manner: V.I. = 50′. If it is not so marked, look at the height of two adjacent contours and see the difference in level between them. In this connexion I might mention that I once found an Ordnance map which was contoured with two V.I.'s. It was a very steep piece of country, and, I presume, too steep to contour at the usual interval, and so the V.I. over a certain height had to be increased. It is worth remembering, as it may be so on other maps in very steep and hilly districts.

The next thing to do with the map is to set it. A map is said to be set when the true North on the map points to the North Pole. If the directions between features on the ground be now compared with these directions as shown on the map they will be seen to be parallel.

(1) To set a map with a compass. If the magnetic North is marked on the map, lay the compass over this and without disturbing the compass turn the map until the compass-needle points exactly along the magnetic North line. If the magnetic North is not marked on the map use the true North. It will be found near enough for purposes of map reading.

You will notice that I have used two expressions with regard to the North, i.e., "true" and "magnetic." The difference is caused by the fact that the true North Pole is not the same as the magnetic North Pole. Of course the compass-needle points to the latter.

In order to understand this question of the variation of the compass it is necessary to describe the instrument in general use in the Service. We all know what a compass is and how the needle always points in the direction of the North. A Service compass has a circular card dial fitted over the top of the needle, this moves with the needle. On the top of the card a North and South line is marked, and the edge of the card is divided into 360 degrees. The bearing of any point from any other point is the number of degrees the first point is away from the magnetic North reckoned always from the North through East, like the hands of a clock, and the variation of the compass (if the compass is absolutely correct) is the bearing of the magnetic from the true North.

There are various ways of ascertaining the North approximately which are of great use when setting a map.

(i) By night of course the North Star gives the North. This equally of course applies only to the Northern Hemisphere.

(ii) In the Southern Hemisphere the Southern Cross may be used.

Get a piece of paper and divide the edge into eleven parts, hold this up to the Cross and make the ends of the first and third divisions coincide with the head and tail stars of the long arm of the cross, then the end of the eleventh division will give the direction of true South roughly.

(iii) As a general guide; at the equinoxes, i.e., for practical purposes March and September, the sun rises and sets due east and west.

(iv) At noon the sun is roughly due South in the Northern Hemisphere and due North in the Southern Hemisphere.

(v) By means of a watch: (*a*) In the Northern Hemisphere point the hour hand at the sun, then a line from the centre to a point half way between the hour hand and the fig. 12 gives a South line roughly. (*b*) In the Southern Hemisphere point the fig. 12 at the sun and a line as before will give a North line roughly.

All these are rough guides for setting a map which do not depend on the use of the compass at all.

(i) When you know where you are on the map.

(ii) When you do not know your position on the map.

In the first case place yourself on a road, railway, river or other clearly marked feature and move the map so that the road as shown on the map points along the road on the ground.

In the second case; look out for two or three objects clearly marked on the map and then twist the map so that the positions on the map and the ground correspond.

You now know the scale and V.I. of the map and having set it by one of the above methods you can now compare it with the country. There are two methods that are particularly useful for practice in reading a map.

(*a*) First take your map and imagine yourself on some point looking in a certain direction and try to picture to yourself what you will see from that point, how far off objects will appear, where the roads, bridges, railways will fall in the landscape.

(*b*) Secondly, take a map to any fairly commanding spot; now have a good look at the ground and see if you can imagine what a map on the scale which you possess would look like; after you have had a thorough good look round and have made up your mind, take out the map and see how near you are to what is actually on it.

To use these two methods is better than to take up a map and compare objects, features, &c., one by one, with the ground. The second of these methods is, I think, more useful practice for sketching than for map reading. They both have the advantage of stimulating the imagination, and with constant practice a very good idea of the ground indeed may be obtained solely from the map.

In practising these two methods on the ground one must not be misled by the fact that on small scale maps a certain amount of detail has been left out, e.g., a small road might appear on a 1-in. map which might be left out altogether on a ½-in. or ¼-in. map, or an unimportant

stream disappear. In such a case the only thing that will put one right is a knowledge of the distance, e.g., if from your point of observation you see a road leading up to a small house a bit off the main road do not let it confuse you if you cannot pick it up on your map; just leave it alone and look for something more prominent.

Also watch the spot levels on your map; these will help you to fill in a lot of the little features which are too small to be marked by the 100-ft. contours of the 1-in. map. In fact in a flat country like the country round York one would have to go almost entirely by spot levels and the directions of the streams in visualizing the shape of the ground.

Finally let me impress on you the hopelessness of trying to learn map reading without constant practice on the ground. You may read books or you may listen to lectures, both good in their way and as far as they go, but without practice both are comparatively valueless, and when practising never use a bigger scale than ½ in. to 1 mile—they are the biggest that would ever be available on service for anyone except Staff Officers, and very frequently one might find that nothing bigger than 4 or even 8 miles to the inch could be procured.

Echoes from the Past.

Extract from Colonel Hall's Memoirs.

CELORICO (A HOSPITAL STATION).[1]

[December, 1811.]

WHEN the reader of the *Gazette Extraordinary* has sighed over the returns of killed and wounded, and exclaimed, "Ah! poor fellows, war is certainly a shocking thing," he believes he has paid his full tribute of sympathy to its calamities and lamented everything that is lamentable about it. He is ignorant that for one man who meets an easy and comparatively enviable death in the field, at least twenty descend to an obscure grave at the hospital station. During the autumn of 1811, at Celorico only, from 50 to 100 men were buried daily (it was observed that the men who had been at Walcheren were the first to be attacked by fever in the Peninsula, and were seldom known to recover), and even after I arrived in the winter, from ten to twenty corpses were carried daily through the streets with scarcely the fragment of a tattered cloak, or a few boughs, to shroud their ghastly remains, and in this state were flung into a hole, which constituted a common receptacle

[1] Reprinted from the *Journal of the Royal United Service Institution*, No. 418, December, 1912, by permission of the Editor.

without the town. Death was too common a guest to be treated ceremoniously.

During the sultriest part of the season the crowded state of the hospitals (an evil irremediable, perhaps, considering the means of accommodation) tended greatly to increase the virulence of contagion. Two patients occupied each bed, and when one died another was brought in to fill his place, and share in mind as well as body, the infection of his disease. Another evil, even more fatal, arose from the want, or worse than the want—the ignorance of the medical staff. There were doubtless at the head of the department men both skilful and conscientious, but amid such a pressure of duty, they could do little more than give a very general inspection to the several hospitals, while the detail of management fell upon hospital mates, many of whom were grossly inattentive and ignorant of the first rudiments of their profession. Nor is this extraordinary. The demand in this branch of the service was very great, the pay very small, the prospects unattractive. Few young men, therefore, of education and promise would give up the chance of establishing themselves at home, and hazard their lives upon so barren a speculation; the void was consequently filled up without much scrutiny into the qualifications of the candidates. If, therefore, a few young men of talents and information were still to be found among the ignobler band of hospital mates (and my own experience justifies me in affirming there were few such) it must be ascribed rather to extraordinary good luck, than to any merit in the system according to which they were selected.

Another evil in the medical department was the fraudulent application by the hospital mates of the comforts[1] intended for the sick to their own use. Nor do I mention this as ground of severe reproach to them. I doubt if in their situation I should not have acted in the same manner. They were frequently several months without pay; they were not allowed the indulgence of a soldier as their servant. Their duty required an incessant attendance of the most painful nature, and I am convinced that for young men accustomed at least to the ordinary comforts of life, there were few whose constitutions could have supported, especially if they were conscientious in the discharge of their duty, the fatigue they must have undergone, both in mind and body, on the ration allowance of a pound of lean, tough beef, as much bread or biscuit, often

[1] Such as poultry, wine, spirits, tea, sugar, lemons, &c., which were delivered from the Commissariat store, upon a receipt signed by the medical officers of the several hospitals.

mouldy, and a pint of sour wine, fit to be used as vinegar. Besides, however, the probable detriment of the sick, whose comforts were thus diverted into another channel, and the degradation of the *medicos* themselves, who were thus subjected to the familiarity and contempt of the sergeants and orderly men attached to the hospital, the loss thus occasioned to Government was, as I had once the curiosity to calculate, more than equivalent to such an addition to their pay as would have placed them above the necessity and temptation of having recourse to means, from which, as gentlemen, they must have revolted with disgust and shame. If the situation of the sick soldiers was far from what humanity would have wished it, that of the officer under similar circumstances was still more deplorable. No provision was made for his accommodation in the hospital, and if he was below the rank of a field officer, he could look for little comfort in a quarter. To prevent exactions on the inhabitants, an order has been issued limiting the claim of quarters to the bare rooms the individual was, according to his rank, entitled to. In such towns as Coimbra, Abrantes and Celorico, where the depôts of sick had been long established, and the inhabitants had from habit grown callous to their wants and sufferings, this order was literally acted upon, and the officer who arrived from the army exhausted with pain and disease, found nothing but the floor on which to lie.

AN ASSISTANT SURGEON'S KIT IN 1827.

By Colonel R. H. FIRTH.

In examining some old papers which were in a long-forgotten box in one of the vaults belonging to the Adjutant-General's Branch at Army Headquarters, India, the following curious document came to light. It belonged to a series of papers relating to the old Madras Army which had been sent to Simla from Ootocamund. As it is desirable that all details throwing light upon the conditions of service of medical officers in the old days should be preserved I think its publication in our Corps Journal is not only justifiable but should be of interest to many. It runs as follows :—

"No. 244.

"Sir, "To the Adjutant-General of the Army.

"Para. 1st. I have the honour, by order of the Medical Board, to acknowledge the receipt of Captain Hitchen's letter, dated the 7th instant, requesting that they would furnish a list of the necessaries which might be considered as a proper equipment for a sub-assistant Surgeon, on Field or foreign service.

"Para. 2nd. The Board accordingly direct me to transmit, for submission to His Excellency the Commander-in-Chief, the annexed list No. 1, exhibiting the individual articles, with their prices, which has been framed from several statements furnished to them; and, I am further directed to annex an abstract No. 2, of the computed value of a Sub-Assistant Surgeon's field equipment, which the Board would recommend to the consideration of His Excellency, as being well adapted for the intended purpose of fixing on a rate of compensation for loss of baggage for persons of that grade.

"I have the honour to be
"Sir,
"Your most obedient Servant,
"WM. SCOT,
"*Secretary to the Medical Board.*

"*Fort St. George,*
"*Medical Board Office,*
"29th *March*, 1827.

No. 1.

A LIST OF WEARING APPAREL AND NECESSARY FURNITURE, &c., SUPPOSED TO BE POSSESSED BY A SUB-ASSISTANT SURGEON ON FIELD SERVICE.

	R.	*A.*	*P.*
12 shirts at 1½ rupees each ..	18	0	0
12 pantaloons at 1½ ditto ..	18	0	0
12 white waistcoats at ¾ ditto..	9	0	0
6 white jackets at 1½ ditto ..	9	0	0
12 pocket handkerchiefs at ½ ditto	6	0	0
6 coloured ditto at ½ ditto ..	3	0	0
1 black silk neck kerchief ..	1	12	0
6 white neck kerchiefs at ¼ rupee each	1	8	0
12 pairs cotton half hose ..	7	0	0
2 pairs night drawers at ¾ rupee each	1	8	0
6 towels at ¼ rupee each ..	1	8	0
1 woollen cloth pantaloon ..	22	0	0
1 ,, ,, round jacket..	17	8	0
1 ,, ,, waistcoat ..	2	4	0
1 ,, ,, greatcoat (2nd sort)	22	0	0
1 round hat	17	8	0
2 pairs of suspenders at ¼ rupee each	0	8	0
2 ,, ,, boots	4	0	0
2 ,, ,, shoes	1	12	0
1 ,, ,, slippers	0	4	0
1 small looking-glass	2	0	0
Brushes	3	0	0
6 cakes of soap..	1	8	0
1 umbrella	5	0	0
1 camp cot	10	8	0
1 ,, stool	2	8	0
1 ,, table	7	0	0
1 pair of boxes	21	0	0
1 blanket	6	0	0
2 pillows..	2	8	0
4 pillow-cases at ¼ rupee each	1	0	0
1 cotton carpet..	2	8	0
2 white sheets	4	0	0

	R.	*A.*	*P.*
1 palampore	5	0	0
1 single-poled tent	52	8	0
1 saddle and bridle	25	0	0
1 riding horse	70	0	0
1 silver table spoon	7	0	0
1 ,, tea ,, ...	2	0	0
1 ,, dessert ,, ...	4	0	0
1 pair large knife and fork ..	2	0	0
1 tumbler and 1 wineglass in leather case..	3	0	0
1 japanned teapot	2	0	0
1 large sneaker and saucer ..	1	0	0
2 flat plates	0	8	0
2 soup plates	0	8	0
1 china jug	1	0	0
1 glass salt-cellar	1	0	0
1 small tea kettle	1	8	0
4 small canisters for tea, coffee, sugar, and curry-stuff ..	2	0	0
2 bottles of brandy	2	8	0
2 ,, ,, madeira	3	0	0
1 corkscrew	0	8	0
1 small lanthorn	1	8	0
1 Bhurty bag	1	0	0
1 small mussack with pipe ..	1	0	0
1 ,, brass pot	3	0	0
2 ,, ,, basins	3	0	0
1 iron frying pan	1	0	0
1 basket for cooking things ..	0	4	0
1 small writing box to contain 2 quires China, 1 quire letter and 1 quire foolscap paper, few quills and wafers, and an inkpot	10	8	0
A Rattan strainer, ladle and cooking knife	0	8	0
Total Madras rupees ..	440	4	0

No. 2.

ABSTRACT STATEMENT OF THE COMPUTED VALUE OF THE EQUIPMENT OF A SUB-ASSISTANT SURGEON ON FIELD OR FOREIGN SERVICE.

	Equipment	Valuation of articles		
		R.	*A.*	*P.*
Linen clothing	Shirts, waistcoats, pantaloons, stockings, handkerchiefs, &c.	85	0	0
Woollen clothing ..	Jackets, trousers, greatcoat, &c.	85	0	0
Sundries	Cooking utensils, horse, saddlery, boots, shoes, brushes, &c...	135	0	0
Camp equipage	Tent, trunks, cot, bedding, table, chair, &c. ..	115	0	0
Table equipment ..	Plates, dishes, spoons, knives, forks and supplies, &c.	30	0	0
	Total ..	450	0	0

WM. SCOT,
Sec. Medical Board.

The foregoing is given exactly as it is written in the original document, which is in a remarkably good handwriting though the ink is faded. To us, serving in India in 1913, some of the articles seem quaint and the prices even quainter. Many of us would be glad to get our shirts, drawers and white jackets at 1 rupee 8 annas. The same can be said of white waistcoats at 12 annas or boots at 2 rupees the pair. An umbrella at 5 rupees seems funny, and so does a riding horse at 70 rupees, but much depends upon what kind of horse or umbrella we want to take on field service. It is noticeable that a lanthorn costs as much as a bottle of Madeira, and an iron frying-pan nearly as much as a bottle of brandy. While we do not take brandy and Madeira with us now as part of our personal equipment, most of us would hesitate to fit ourselves out with writing material to a value of ten rupees. Possibly, some day, the man will be forthcoming who will put together a complete history of the military medical officer; one can but hope that this note may be of use to him, and there is no more fit place for the collection of material for that history than the pages of our Corps Journal.

Reviews.

Care and Treatment of European Children in the Tropics. By Montagu Harston. London: Baillière, Tindall and Cox, 1912. Pp. xvi and 226. Price 7s. 6d. net.

This book on diseases of children in the Tropics comes to fill a gap in our literature of tropical disease, and will be welcomed accordingly. The introductory chapters are concerned with the general management and hygiene of infants and young children in the Tropics; they represent the author's practical experience, and in them will be found many useful hints. The remarks of Dr. Harston on the necessity for a routine examination of the blood and fæces are specially applicable to the circumstances of children's diseases, though they apply just as well to adult practice in the Tropics. In the chapter on malaria the many ways in which the symptoms of this disease in children differ from those in adults are well brought out. A special point is made of the necessity for keeping a sharp look out for malaria as a complication of other diseases. This is specially important in children who, taking it all round, are more liable to pernicious attacks. From the description of the parasite one might be led to infer that exflagellation of the microgametocyte occurs in the human host; this is probably a slip in writing. With regard to the use of quinine, we note that he recommends the addition of atropine where quinine causes urticaria; this is a useful suggestion. He draws attention to the dangers of tetanus from intramuscular injections; but at the same time the strength of quinine (1 in 2) which he recommends when one is driven to intramuscular administration is just such an one as would increase the risk of tetanus, and there is no advantage whatever in using such a concentrated solution. For urgent cerebral cases he recommends intravenous inoculation, but does not give the strength to be used. The practitioner who was unaware of the dangers of using too strong a solution intravenously might very easily kill his patient. Incidentally we might mention that hæmoglobinæmia is not the term for a deficiency of hæmoglobin.

In the chapter on typhoid fever the method of taking blood for cultures might be explained more clearly, especially as there are peculiar difficulties in the fat arms of children. There is no advantage in pointing the needle towards the hand; the great secret is to keep the eye of the needle up, and the syringe nearly parallel to the skin. Similarly, in the chapter on cholera, it would have been an improvement if the author had given more detailed instructions for intravenous injection; any one who has had to do this operation in a collapsed child will realize the difficulties that have to be overcome. The alternative of intraperitoneal injection is not dealt with. Sir Patrick Manson, in his introductory remarks, says that possibly critics will take exception to the treatment recommended in some cases; we hazard a guess that he had in his mind the treatment recommended for acute dysentery. Dr. Harston very rightly insists on making a diagnosis of the causal organism; then in the paragraphs on treatment he says that he does

not recommend ipecacuanha for acute dysentery unless other measures fail—this on account of the discomfort produced. One cannot protest too strongly against such an omission when one is dealing with amœbic dysentery. Ipecacuanha is a specific remedy for this disease, and to omit it because of the discomfort produced is almost as bad as to omit quinine in malaria because of its upsetting the stomach. Besides, there are many ways of overcoming the discomfort produced. We take it that the book was written before Rogers published his recommendation of emetine hypodermically. This method does away with the trouble from vomiting, and in our hands has proved very useful. One advantage of it is that one can by its use establish a tolerance for ipecacuanha, and so carry on the later treatment with it. Another recommendation which departs from established practice is that of a douche in acute dysentery, from a height of two feet. When one remembers the extreme tenuity of the bowel in a dysenteric child, the danger of such a procedure becomes obvious.

A specially good feature of the book is the chapter on worms, which is illustrated by some of Dr. Bell's beautiful microphotographs. Apart from the points which we have criticised, the book is an excellent one on the subject; it contains a large amount of very valuable information, and is one which should be in the hands of every one who is called to deal with children in the Tropics. W. S. H.

THE INTERNAL SECRETORY ORGANS: THEIR PHYSIOLOGY AND PATHOLOGY. By Professor Dr. Artur Biedl. London: John Bale, Sons and Danielsson, Ltd., 1912. Pp. viii and 586. Price 21s. net.

There are occasions when even the most hardened reviewer feels constrained to lay aside the omniscient "WE" and, with a reversion to native honesty and the first person singular, admit that he can furnish only humble admiration instead of expert criticism. There must be few, even amongst experimental physiologists, who are in a position to do more than this when it is a question of reviewing a work by Professor Biedl on the subject of the internal secretory organs. In reading the book now before us, we have experienced once again a sensation to which we have been rather subject of late, a feeling of deep commiseration for the general practitioner of modern times, whose duty it is to keep in touch with the advances of science. We have seen him abused for failing to recognize the early indications for surgical interference, we have heard him reviled for presuming to administer vaccines in the same vein of happy empiricism with which he exhibits digitalis, and we now realize the responsibility which he incurs in prescribing thyroid extract or injecting adrenalin without a full and comprehensive knowledge of the ductless glands. His case is not quite hopeless, however, for in the volume under review Professor Biedl has provided an excellent summary of the subject which makes available, in a comparatively small bulk, a rational basis for the practice of organo-therapy. The work opens with a lucid consideration of the thyroid apparatus, in which the author shows how the observation that tetany followed the removal of the thyroid really depended upon the simultaneous removal of the parathyroids, an accident especially likely to happen in certain animal experiments where the parathyroid glands are included in the thyroid gland. This part of the book

furnishes much information of use to the surgeon, while an excellent diagram on p. 46 gives, at a glance, a clear idea of the clinical results of increase or diminution of the secretion of the thyroid and parathyroid glands which should be of value as an aid to memory on this subject. A very large part of the book is given to the suprarenal system, to the knowledge of which the author has made important contributions. His method of carrying out the removal of the suprarenals in two stages, by first transplanting them, the animal being anæsthetised, to a superficial position under the skin of the back, from which site they can later be removed without the shock of a serious operation or an anæsthetic, has enabled the symptomatology of suppression of the suprarenal function to be studied without the introduction of surgical side issues depending on manipulation and chloroform. The suprarenal system presents problems of the most intense interest and complexity.

Taking first the medullary portion, this is one of the largest deposits of chromaffine tissue in the body, and this tissue by means of its hormone, adrenalin has a rôle of the highest importance in the economy. Adrenalin is a typical disassimilatory hormone reinforcing the katabolic activity of certain tissue elements. Its effects are confined to organs with a sympathetic innervation and invariably coincide with the effects of electrical stimulation of the sympathetic. To quote our author, "the activity of the hormone elaborated by the adrenal system is the permanent expression, during the life of the individual, of the genetic relationship between the adrenal and the sympathetic nervous systems. . . . Its activity is fundamentally and unceasingly necessary to the normal function of the entire sympathetic system." When it is recalled that the sympathetic system presides over the maintenance of the tone of the cardiac and vascular muscles, that it regulates the sugar content of the blood, and, according to recent observations, is concerned also in the metabolism of albumin and salt, the functional significance of the adrenal system will be realized. As regards the suprarenal cortex, some interesting work has been done on its antitoxic action, but our knowledge is far less complete than in the case of the chromaffine tissue. Some of the most interesting chapters in the book deal with the generative glands. In a preliminary consideration of the problems connected with the determination of sex, the author assumes the existence of a hermaphroditic primitive genital trace, together with the dependence of the somatic and psychic sex characteristics upon the internal secretory activity of the genital glands, the final development in one direction or the other being conditioned by the preponderance of one or the other variety of specific genital tissue. But, with all due deference, we cannot refrain from wondering what forces determine this preponderance of one variety of genital tissue. Is it quite a matter of chance? We read further on that instances occur of the development of "male" characters in females as a result of deficient ovarian hormone (p. 364), while it is shown clearly that "female" characters never supervene in the male as a result of castration, this operation leading to a suppression of "male" characters only. Does not this suggest that both "male" and "female" characters coexist in the female, the former being recessive, the latter dominant, and that the male, being free from "femaleness," becomes merely "neuter" in the absence of the hormone on which his secondary male characters depend? Perhaps there is no excuse for introducing the name of Mendel

into the discussion when the author has left it out, but the Mendelian theory offers a very tempting explanation of sex. Space does not permit a fuller consideration of this delightful book, though much remains to be said. We can only add that its perusal has given us the greatest pleasure, and that we heartily recommend it to all medical men who desire a fuller knowledge of one of the most important branches of physiology and pathology. S. L. C.

SNAKE-BITE AND ITS SCIENTIFIC TREATMENT. By F. W. Fitzsimons. London: Longmans, Green and Co., 1913. Pp. 15. Price 1s.

This small pamphlet by the director of the Port Elizabeth Museum is intended for popular use. It deals with the use of an anti-snake bite outfit which the author appears to have patented. The treatment consists essentially in the injection of a polyvalent antivenine. The pamphlet should be useful to people in snake-infested districts who are unable to get a doctor quickly. The information given is clear and for the most part sound, but we must take exception to the method of purifying the skin. Apparently the outfit contains a powder (boric acid?), which it is recommended should be moistened with saliva before application to the skin if water is not available. It would be better to leave the skin alone than to do this. W. S. H.

THE MOSQUITO: ITS RELATION TO DISEASE AND ITS EXTERMINATION. By Alvah H. Doty, M.D. London: Appleton and Co., 1912. Cloth. Illustrated. Pp. 79. Price 2s. net.

This little book may best be described as a popular pamphlet for use in mosquito-infested districts. The author's aim has been "to bring together, in a plain and practical way, such information regarding the mosquito and its extermination as will be useful to those who may be interested in the work." In plain and simple language, and with the aid of illustrations, the main points in the identification, the life-history, and the habits of the mosquito are rapidly sketched. As regards their breeding-places mosquitoes are divided into two groups: (*a*) inland mosquitoes, that breed in fresh water, and (*b*) those that breed in salt water swamps on the coast. The measures to be adopted in the extermination of each variety are indicated in a practical manner and in a way that will appeal to the small landowner. Special stress is laid on the destruction of hibernating mosquitoes by means of sulphur dioxide. The last chapter gives some hints on the treatment and the prevention of bites. In no sense can this be termed a scientific treatise on the subject, and it does not claim to be so.

J. C. K.

THE ART OF MARCHING. By Colonel George Armand Furse, C.B., late of the Black Watch. London: William Clowes and Son, Ltd., 1901. Pp. viii. and 584. Price 12s. net.

The author deals exhaustively with his subject. A large part of the book is taken up with the consideration of various historical marches, a further portion with purely military questions such as the disposition of troops on the march, &c. This leaves comparatively only a few chapters of importance to the medical officer, such as those on the training for the

march, the rate of marching, and the length of marches. The author's views in these are very sound. We have, however, since then progressed somewhat. The book, in short, suffers from the fact that it is twelve years since it was written. Many of the theories then expressed have since become acknowledged facts and others have been built up on these, making the whole more interesting as a record of what was then the latest view than useful as a text-book for the present-day student.

J. A. B.

Current Literature.

Vaccine Treatment of Enteric Fever.—Boinet (*C. R. Soc. de Biol.*, March 14, 1913, p. 507) treated fifteen cases of enteric fever with three or four daily doses 2 c.c. of Besredka's sensitized vaccine. The course of the fever was shortened and was less liable to relapses; the symptoms became milder, and after the third or fourth dose, if given within the first ten days of the disease, convalescence progressed rapidly: The inoculations appeared to increase the bacteriolysin and antibodies in the blood.

Ardin-Delteil, Nègre and Raynaud (*C. R. Soc. de Biol.*, February 28, 1913, p. 371) found that the agglutinative power of the blood of enteric patients who received Besredka's vaccine did not exceed $\frac{1}{1000}$; in untreated cases it may attain $\frac{1}{5000}$ to $\frac{1}{10000}$. In rabbits also the elaboration of agglutinins was less under immunization with sensitized living cultures than with untreated living cultures of the typhoid bacillus. On the other hand both in men and animals sensitized vaccine caused a rapid increase of the bactericidal power of the blood; and the antibodies estimated by the complement deviation test appeared earlier and in greater quantities, hence they recommend the use of Besredka's sensitized cultures in the treatment of enteric fever.

C. B.

Sore Throat Epidemic Caused by Milk.—W. H. Frost (Public Health Report Reprint No. 103, 1912) reports an epidemic of more than 1,000 cases of sore throat which occurred in Baltimore and its vicinity during February and March, 1912. The disease was marked by its sudden onset, high fever, diffuse inflammation of tonsils and fauces, enlargement of the cervical glands and great prostration; the number of deaths, however, did not greatly exceed thirty. Cultures from the throat, from discharges from the middle ear, and from peritoneal exudation showed the presence of a diplo-streptococcus which resembled the pneumococcus in smears. The colonies on agar were larger and moister than those of *S. pyogenes*; uniform turbidity was produced in broth; milk was acidified and sometimes clotted; dextrose and lactose were fermented, but raffinose, mannite, and inulin were unchanged; bile dissolved the organisms to some extent: it was pathogenic to animals. The infection originated in one of the larger dairies of Baltimore and was disseminated also by contact. Milk obtained from this dairy contained the above described streptococcus: one of the staff of the dairy, moreover, was a

carrier of this micro-organism. The milk was treated by the flash system of pasteurization, that is, its temperature was raised 165° F. for two and a-half minutes: during a few days in February, however, the apparatus was out of order. Frost thinks that to render milk free from danger, it must be submitted to a temperature of not less than 145° F. for at least twenty minutes. The monograph gives references to similar epidemics.

C. B.

The Luetin Test in Syphilis.—Rytina (*New York Med. Record*, March 1, 1913, p. 384) has used the luetin test in 117 cases. Luetin, which is prepared by Noguchi, is an emulsion of six strains of *Treponema pallidum* destroyed by heating to 60° C. for one hour, and the addition of 0·5 per cent cresol. Luetin is mixed with an equal bulk of sterile physiological saline fluid immediately before use, and 0·07 c.c. of this dilution is injected into the skin of the arm with a very fine needle. As a control a similar quantity of the culture medium alone is inoculated intradermically into the other arm.

If the case be not syphilitic, slight redness appears at the puncture, lasting at most forty-eight hours, or after the first twenty-four hours in about 50 per cent of the patients, a raised and indurated papule arises which is surrounded with erythema; this might be mistaken by the inexperienced for a positive reaction, but it has no significance. The papule recedes, and by the fifth day nothing but a stain remains.

When the reaction is positive, a large indurated papule, 5 to 10 mm. in diameter, is formed, around which is a zone of redness and swelling. In the course of two or three days it becomes livid red, and does not disappear until seven to ten days after the inoculation. A pigmented mark remains for two or three weeks. Such a reaction the author observed three times in secondary, six times in tertiary, and once in parasyphilis.

A pustular form of positive reaction also occurs, in which the papule, after being indurated for four or five days, becomes capped by small vesicles, and softens in its centre. The pustule may rupture leaving an opening with indurated margins; a crust forms which falls off after a few days, leaving little scar, but a pigmented spot which persists for several months. Sometimes the pus is absorbed without lesion of the skin. The pustular reaction was observed in one case of primary, two of secondary, nine of tertiary, and three of para-syphilis.

In the torpid positive reaction, the slight erythema which arises at the site of puncture fades away, and the reaction is recorded as negative, but eight to thirty days later the site of injection becomes swollen and red, and assumes the characters described above. Torpid reactions were noted in four cases of secondary, five of tertiary, one of latent, and one of hereditary syphilis.

Luetin caused no reaction in twenty-eight persons who had not suffered from syphilis.

It is known that the skin of those who have been infected is more prone to be affected by slight injuries than that of healthy people; hence the curious observation was made that the intradermic injection of the culture medium alone into the arms of syphilitics caused similar changes as the luetin itself. In fourteen specific cases the appearance of the control arm resembled the reaction caused by the luetin; in five the reaction

was more marked on the control side. Nevertheless, when the culture medium alone was injected intradermically into healthy persons no reaction of any kind resulted.

The author concludes that luetin is harmless, and is specific in its indications, but experience is necessary to interpret mild reactions. The response is usually negative in primary and secondary untreated cases of syphilis, but it is positive in nearly all cases of tertiary, latent, congenital and para-syphilis, in many of which the Wassermann test may be negative. In rare instances the luetin reaction is negative, although active signs of late syphilis are present.

C. B.

Treponema Pallidum in the Brain of General Paralytics.—Noguchi and Moore (*Journ. Exp. Med.*, Feb. 1, 1913, and *Comptes Rendus Soc. Biol.*, Feb. 21, 1913) examined the brain in seventy cases of general paralysis by means of a modification of Levaditi's method, the particulars of which are not given, and discovered *Treponema pallidum* in twelve. The spirochætes were present in all the layers of the cortex, except the outer or neuroglia stratum, and also in the subcortical medulla. They were absent in the pia mater and the vascular sheaths. In the later communication Noguchi announces that he found *T. pallida* in enormous numbers, exceeding what may be seen in sections of syphilitic fœtal liver, in the cortex and medulla of another paretic, more especially in the motor area. He has detected the spirochætes in preparations of the fresh brain with the aid of dark ground illumination. He cautions the observer against mistaking tortuous fibres for *T. pallidum*.

C. B.

Chicken Sarcoma Caused by a Filterable Virus.—Rous and Murphy have published their researches on a transmissible tumour removed from a Plymouth Rock hen, in the *Journal of Experimental Medicine* for the years 1910, 1911, and 1912. Emulsions of later generations of this growth were filtered through a Berkefeld, "No. 5 medium," candle, and were injected into forty fowls of the same variety. In twelve, tumours appeared after an incubation period of about four weeks. Profuse metastases were found in some.

In the February number of this year they report on the variations which have occurred in the structure and behaviour of this growth. Material delivered from a single tumour, either in the form of dried or glycerinated tissue, or a Berkefeld filtrate, will produce in some hens a pure spindle-celled sarcoma, in others a giant-celled, and in others a mixture of fusiform and round cells, among which are blood extravasations. Such changes are similar to those which take place in the transplantable tumours of mammals.

C. B.

Statistics of Resection of the Stomach.—During the last five and a half years some 800 operations on the stomach have been performed in Küttner's Clinic at Breslau, 157 of which were resections. Weil (*Berl. Klin. Woch.*, March 3, 1913) in his account of these cases of gastrectomy, excludes four resections of the cardiac end, two resections of the stomach and duodenum on account of duodenal ulcer, an extirpation of a cancerous tumour of the gall-bladder which invaded the stomach, and a removal of

a stomach destroyed by swallowing acid. There remain, therefore, 149 operations of resection of the stomach. In fourteen, chronic ulceration was found, but as it was impossible to determine at the operation whether malignant changes had set in, the stomach was removed; three of these patients died in consequence of the operation; the others are now in good health. Of 135 patients suffering from cancer of the stomach two-thirds were men; half of the patients were under 50, and three under 30 years of age. In about a quarter of the cases dyspeptic symptoms had been noted for years, in the majority, they had been complained of only for a few months. Pain was absent in 10 per cent of the cases, and vomiting did not occur in 20 per cent. Loss of weight was universal. The diagnosis of gastric cancer was attained in 80 per cent of the cases before the operation by the presence of a palpable tumour, or increased resistance in the epigastrium. X-rays are of no service in the detection of cancer of the stomach in its early stages, though skiagrams may show the tumour in advanced cases. In four or five instances only, when an exploratory laparotomy was undertaken for vague symptoms, was malignant disease of the stomach discovered. Küttner's was the operation employed in the majority of instances. In 20 per cent of the resections the liver and pancreas were implicated, and in 75 per cent the lymphatic glands were the seats of metastases. The tumour was situated in the prepyloric area in half the cases, on the lesser curvature in a third, and on the greater in the remainder. The histological character of the growth was no aid in prognosis.

Of the 135 patients who underwent resection of the cancerous stomach, 20 per cent died of the operation. Peritonitis was the cause of death in 75 per cent of these, which was frequently attended with pneumonia. Pneumonia alone caused death in 16 per cent of those that succumbed. One hundred and four patients, therefore, whose stomachs had been removed on account of cancer, were discharged hospital; forty are still living. But of those on whom the operation was performed in the years 1907, 1908, and 1909 2 to 3 per cent only remain well and free from recurrence, although 16 per cent survive. This percentage of cures is small, but it would represent great saving of life among the 15,000 persons who die of cancer of the stomach every year in Germany. On comparing the present with past statistics it is found that the operative mortality is less, but that the after results are no better, and the cases suitable for operation have been proportionally fewer. Hence the future of this operation hinges on improvement in the methods of early diagnosis of gastric cancer.

C. B.

Extract from the Report of the Department of Sanitation of the Isthmian Canal Commission for the month of December, 1912.

Report of Health Officer of Colon.

"The number of adult mosquitoes reported caught in the barracks shows a considerable increase over that of previous months. Several anopheles breeding areas have been found outside of our worked area. The worked area at Mount Hope has been extended within the past year so that now it includes almost twice as much territory as the worked area for this district in 1911. The range of flight of the anopheles mosquito appears to be much greater than has heretofore been accepted,

as we have found all large breeding areas nearly two miles from our labourers' barracks, and while the breeding areas were undisturbed the anopheles mosquitoes were numerous in the barracks, but after eliminating these breeding areas the catch in the barracks has fallen off in proportion to the completeness of the work in eliminating the breeding places. Our sanitary inspector for Mount Hope district has reported on several occasions that he has found anopheles larvæ in full salt sea water."

Surgical Experiences in Balkan War.—Regt. arzt Dr. F. Tintner (*Militärarzt*, March 1, 1913) gave an account of his surgical experiences in the hospital at Jamboli (six days' march from Kirk Kilisse), from which the following notes have been taken. He saw altogether some 1,200 wounds, of which only a few were caused by cold steel, about 70 per cent were inflicted by rifle bullets and some 20 per cent by shrapnel bullets and fragments of shell. The rifle bullets in most cases were not deformed, in two instances the core had separated from the mantle, which had split in two; on the whole the rifle bullets, except when they struck broadside on, inflicted humane wounds. Shrapnel bullets frequently lodged in the body and inflicted a contused wound which almost always became infected. In some wounds of the jaw and skull the splinters of bone acted as a plug for the wounded blood vessels; on attempting to withdraw the splinters free hæmorrhage set in; this possibility must be borne in mind when dressing wounds in which there is much splintering of bone.

The first field dressing was of considerable use from a surgical point of view and even more so from the sense of comfort induced by its application. Tintner does not, however, approve of an absolute rule to apply a dressing to every wound. In this campaign men wore several layers of clothing in order to keep warm; the act of dragging these off in the bitter cold caused the men considerable suffering. Tintner thinks it would be better merely to immobilize the fracture, if there is one, and to keep the wounded part at rest till the man reaches some place where a dressing can be comfortably applied, as bullet wounds if left alone heal up readily. The best form of first field dressing was undoubtedly the dry aseptic dressing. The worst wounds were those which had been plugged for the control of hæmorrhage; these were always badly infected, the canal being distended with foul-smelling pus.

There were a few cases of tetanus following wounds of the lower extremities; these cases all ended fatally in spite of the use of antitetanic serum. Tintner was not favourably impressed with tincture of iodine or with mastisol; the latter sometimes caused occlusion of the wound. He says that owing to the pressure of work, it is impossible to disinfect one's hands at the dressing station, and that the only rational plan is to use forceps, which can be quickly sterilized, for handling the dressings. The most important article of medical equipment is plaster of Paris. The sooner a plaster splint can be applied to a broken limb the better the patient's chances of ultimate recovery. An enormous quantity of splints of all sorts should be provided.

Conservative surgery should be insisted on; with rest and nursing marvellous recoveries take place. Even when an operation is necessary,

it should not be performed till the man has had a rest and has recovered from the fatigues of the journey. Operations should except in cases of extreme urgency be deferred till the patient's arrival in a hospital where he can be nursed. Trained nursing sisters are a necessity; amateurs and superficially instructed ladies were worse than useless.

Local anæsthesia was found to be most useful as it saved having an anæsthetist and the patient did not suffer from the shock which always follows the administration of a general anæsthetic.

Stretchers, on which severely wounded patients had been transported for several days, became badly soiled; it is not therefore wise to count on using these in place of bedsteads in the stationary hospitals. The ambulance motor cars and Linxweiler apparatus in trains gave great satisfaction.

The Bulgarian stretcher bearers were extremely brave in fetching wounded from the firing line; their training was not so thorough as could have been desired.

Tintner thinks that wounds of the skull should not be operated on unless thorough asepsis can be guaranteed during the operation and the patient can be kept at rest and properly nursed afterwards. Removal of large pieces of the skull is very liable to be followed by a prolapse of the brain. Some abdominal wounds healed without causing the patient any serious inconvenience; practically all the wounds of the bladder healed up without any complication.

C. E. P.

New Army Biscuit.—*Le Caducée*, January 4, 1913, states that satisfactory trials have been made with the new field ration biscuit. The exact formula is secret, but it contains some sugar and a vegetable fat. Each man received two of these with his morning coffee, one with his soup, eight in lieu of fresh bread, and four to be used in preparing various dishes in the kitchen. The general opinion was most favourable, although some men complained of the sweet taste when eating them with cheese or soup.

C. E. P.

Feeding of Soldiers.—Colonello Medico Filipo Rho, della Regia Marina, has written a lengthy article (*Annali di Med. Nav. e Col.*, October, 1912) in which he criticizes the diet at present issued to the Italian troops. He goes very fully into the calorie value of the individual constituents of the diet and compares the energy value of the ration with the standards laid down by Voit, Pettenkofer, Rubner, Chittenden and others. Rho takes exception to the amount of nitrogenous food allowed in the Italian Navy and especially to the increase in this constituent which is allowed under active service conditions.

The army ration as at present issued contains 102·7 grm. of albumen, 26·6 grm. of fat and 588 grm. of carbohydrate with a total energy value of 3,074 calories. Rho contends that 70 to 80 grm. (not exceeding 100) of nitrogenous food is sufficient in all circumstances and that therefore the proteid is excessive while the fat is too low.

A new ration has been suggested but not yet adopted; it contains 142 grm. of proteid, 49·6 grm. of fat and 576 grm. of carbohydrate, giving a total of 3,405 calories. The Navy ration contains 133 to 147 grm. of proteid, which Rho thinks is excessive. The great defect in all soldiers'

rations is monotony. More sugar, vegetables and fruits should be issued and the quantity of proteid should be reduced.

In Lybia the Italian Army ration contained proteid, 180 grm.; fat, 71 grm.; carbohydrate, 711 grm.; this yielded 4,312 calories. Rho thinks that the proteid is double the amount necessary having regard to the hot climate in which the troops were operating; he ascribes the prevalence of digestive maladies, jaundice and mild fevers to this proteid hyper-alimentation which he thinks produces intestinal auto-intoxication. Rho thinks that the proteid ration should be constant in all circumstances and that the fats and carbohydrates should be increased when harder work has to be done.

H. E. R. J.

Instruction for Army Medical Corps Officers, Austrian Army.—Regulations (*Organische Bestimmungen für den Fortbildungskurs der Sanitätstruppenoffiziere, Vienna*, 1912) have recently been issued which lay down a course of instruction to be taken by Army Medical Corps officers[1] between the second and eighth year of service. The instruction consists of three months' theoretical instruction followed by a course of practical instruction. The subjects comprised in the course are:—Medical tactics, army medical organization, history of the army medical service, feeding of troops, military geography, transport, military law, military administration, army organization, mobilization, map reading, firearms and hand weapons, riding, shooting with magazine pistols.

C. E. P.

Ambulance Train used by the Spanish Army in Melilla.—Medico Provisio D. Anton (*Revista de Sanidad Militar* of February 15, 1913) published a description of the ambulance train (tren-hospital) which was made up of goods vans and passenger coaches, and ran on the mineral railway from Avanzaniento, which was the railroad for the field army, to Nador, about 10 miles from Melilla, the base.

It was formed as follows:—

No. 1, a closed van in which the corpses of officers were brought down.

Nos. 2 and 3, passenger coaches for wounded sitting-up soldiers.

No. 4, a wagon fitted with Linxweiler apparatus for four wounded soldiers on stretchers.

No. 5, passenger coach for officers and officials who would travel sitting up.

No. 6, with Linxweiler apparatus and stretchers for soldiers and N.C.Os.

Nos. 7 and 8, wagons with four stretchers suspended for soldiers.

No. 9, wagon with Linxweiler apparatus and stretchers for officers.

Nos. 10 and 11, wagons with suspended stretchers, some for officers, others for soldiers.

Nos. 12, 13 and 14, wagons fitted with Linxweiler apparatus for soldiers.

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[1] These officers are not medical officers but, subject to the senior medical officer of the hospital or unit, command the personnel doing duty in hospitals and field medical units.

No. 15, passenger coach with sitting-up sick.

Total wounded on stretchers	55
Sitting-up wounded	88
Besides sick	40

The number of medical officers and medical orderlies carried is not stated, but as the train did not take more than one hour and ten minutes on its journey, not much would be required of them.

The Linxweiler apparatus used was type B II, chosen in preference to type A I, and gave great satisfaction, it being easily dismounted and erected, and its spring protecting the wounded from vibration and shocks. During the year 17,357 persons sick and wounded were carried in the train.

H. E. R. J.

Surgeon-General's Report, United States, for the Year Ending 30th June, 1912.—The constantly non-effective ratio for enlisted men was 31·40 per 1,000 in the United States and 43·15 in the Philippines, which is the lowest yet recorded. The admissions were 887·80 in the United States and 1,218·24 in the Philippines. A graphic on page 20 shows the total non-effective ratio from 1888 to 1911. The effect of the Cuban and Philippine expeditions in 1898 is shown by a sudden rise to 69·09 per 1,000, or nearly double that of the previous eleven years. Since 1888 there has been an almost continuous drop.

Recruits.—The principal causes of rejection and ratios per 1000 recruits examined were: Venereal diseases, 111·6; heart disease, 97·9; defects of hearing, 85·6; defects of vision, 74·9; flat feet, 55. Defective teeth only accounted for 22·5 per 1,000 rejections.

Typhoid Fever.—During the year 44 cases of typhoid fever with 6 deaths occurred in the Army in the United States; during 1910 there were 142 cases with 10 deaths; and in 1909, 173 cases with 16 deaths; the admission ratios for the three years being 0·76, 2·42, and 3·03 respectively. Of the 44 cases only 7 had received the typhoid prophylactic.

Antityphoid Vaccination.—A board of officers was appointed in January, 1909, to report on the advisability of employing antityphoid vaccination for the regular army, and also in case of war for the volunteer army. The report was entirely in favour of adopting this protective measure. Up till the spring of 1911 only such men as volunteered received antityphoid vaccination. When the troops were mobilized in the manœuvre camps at San Antonio, antityphoid vaccination was made compulsory for all men. The results were so satisfactory that on June 9, 1911, a General Order was issued directing that all recruits under the age of 35 were to receive the typhoid prophylactic as soon as practicable after enlistment. On September 30, 1911, antityphoid vaccination was made compulsory for every officer and man under 45 years of age. During the first six months of 1912 only seven cases and one death occurred in the army; the diagnosis was made by bacteriological tests.

Venereal Diseases.—During the past year a great deal of attention was paid to the prevention of venereal diseases, but the results have been disappointing; the admission ratio was 163·8 as compared with 155·5 in 1910. Gonorrhœa and soft chancre show a somewhat reduced incidence, but the admission ratio for syphilis has increased from 26·6 in 1910 to 44·3 in 1911. This great increase is mainly due to the fairly general

adoption of the Wassermann test. Numbers of latent cases of syphilis were discovered and shown in the returns as syphilis. About 70 per cent of all cases of syphilis were treated with salvarsan; this necessitated a short admission to hospital, purely for treatment, but which none the less increased the total number of admissions for syphilis. The ratio per 1,000 non-effective for all venereal diseases (p. 58) in 1911 was 8·82 as against 10·14 in 1910: the similar ratios for syphilis alone were 2·82 and 2·71, showing only a slight increase: this shows that the large increase in admissions for syphilis was due not to an increase in the incidence of syphilis, but to the large number of men who were admitted only for a short period.

Prevention of Venereal Diseases.—In almost every station medical officers gave lectures and distributed pamphlets to the men on the physiology of reproduction, the desirability of sexual purity and the dangers of illicit intercourse. In addition to the above, attempts were made to prevent infection by the use of prophylactic tubes with or without toilet facilities. The most successful tube appears to be that invented by Colonel L. M. Maus, Chief Surgeon, Central Division. The tube contains an ointment having the following composition: calomel 25 per cent, phenol 3 per cent, camphor 3 per cent, adeps lanæ 34 per cent, adeps benzoate 35 per cent. Tested in the laboratory this ointment was found to be efficacious against syphilis and gonorrhœa.

Medical inspections for the detection of venereal diseases were made twice a month. In some stations each man who had exposed himself to infection was on his return to barracks obliged to report himself at the hospital for disinfection. Any man who developed venereal disease, and who had not complied with this regulation was court-martialled and severely punished. At Jefferson Barracks out of 2,184 men prophylactically treated only ten developed venereal disease, while the admission ratio was reduced by nearly one-half, most of this being due to disease contracted at some former period.

The pay of officers and men while in hospital as a result of intemperance, indulgence in drugs or other misconduct, is now forfeited in accordance with a fresh clause in the Appropriation Bill.

General Order No. 17, dated May 31, 1912, directed all officers to do their utmost to induce men to lead a clean life. Paragraph 2 ordered all men who had exposed themselves to infection to apply for prophylactic treatment, and directed that those who failed to do so and subsequently developed venereal disease were to be tried by court-martial for neglect of duty. Surprise inspections were also ordered to be held twice a month for the detection of venereal disease among the troops.

Malaria.—The admission ratio for malaria among troops in the United States continues to show a steady decrease; in 1902 it was 96·29 per 1,000, while in 1911 it had fallen to 14·68. At Fort Washington the admission ratio for malaria in 1911 was 333·33 per 1,000: this was higher than the ratio for any post in the United States or even in the Philippines. In consequence of the constantly high malaria rate for this post a committee was assembled to report on anti-malaria measures; the procedure recommended was not begun in time to influence the incidence of malaria during the year 1911. The fort is surrounded by miles of dense bush and swamp, so that some time will be

required to eradicate mosquito breeding places. Wire gauze screens are being fitted to doors and windows. Eight men, in whose blood malignant tertian parasites were found, were transferred to a non-malarious post.

C. E. P.

Army Medical Report of the Prussian (including Saxony and Wurttemberg) Army for the Year October 1, 1909, to September 30, 1910.—The Army was composed of the following categories: Men in their first year of service, 225,500; men in their second year of service, 206,381; men having more than two years of service, 118,483; mean annual strength, 550,364.

The ratios of admissions per 1,000 of strength were: To hospital, 193·4; to barrack hospital treatment, 319·7; to both forms of treatment, 50·8.

The ratios per 1,000 by ranks were: N.C.Os., 382·4; privates, 893·5; one year volunteers, 105·8; reserves called up for training: 505·7.

The ratios by years of service: First year, 781·7; second, 409·2; other years, 418·7.

The mortality was 1·7 per 1,000 of strength.

Infectious diseases show a steady diminution.

There were 222 cases of typhoid fever with 28 deaths.

Tubercle caused 1,027 admissions (= 1·9 per 1,000 of strength) and 111 deaths; only 56 were returned to duty.

Diseases of the nervous system: the total number admitted was 4,490, which shows an increase of 420 over last year.

Venereal diseases caused 11,446 admissions (= 20·8 per 1,000 of strength), with 2 deaths and 924 invalids. The corresponding ratio of admissions for the French Army was 26·4, for the Austrian 54·7, and for the British Army (at home) 65·9. Of the total of 941 deaths in the Army 242 were due to suicide.

C. E. P.

Russian Army. Red Cross Reservist Orderlies.—Army order 523, 1912, authorizes the formation of a new grade of 1st class reservists, viz., Red Cross medical orderlies. Soldiers selected for this grade will undergo a special course of four weeks' ambulance training in the last year of their colour service, and must pass the examination after it. The courses will be held under arrangements made by the Red Cross Society. To qualify for selection, non-commissioned officers and men must be—(*a*) of orthodox religion, (*b*) literate, (*c*) skilled in a trade (saddler, smith, carpenter or cook). The uniform will be of infantry pattern, with grey-blue breeches. The shoulder-straps will be wholly of "invisible" coloured material. The Red Cross badge will be worn on the shoulder straps, on the cap front, and on a white brassard carried on the left sleeve.

C. E. P.

International Red Cross Agency for the Balkans (*Der Deut, Kolonf.*, No. 3, 1913).—The International Red Cross Committee has instituted an International Red Cross Agency in Belgrade. With the sanction of the Servian War Minister, the Swiss Consul-General, M. Voegli, has been placed in charge of the agency, which will, however, remain subordinate to the International Red Cross Committee. The agency will be managed by a small committee composed of representatives of the belligerents and of the foreign Red Cross Societies. Its duties are:—

(1) To collect and distribute all gifts sent to the wounded, to hospitals, &c.

(2) To forward letters to wounded and to furnish information about the wounded to their relatives.

(3) To receive letters and gifts intended for prisoners of war, and to provide means of communication between prisoners of war, and their relatives.

C. E. P.

The Increase of Mental and Nervous Disorders in Germany.—Oberarzt Dr. Mayer (*Deut. militärärzt. Zeit.*, December 5, 1912) has made a long and elaborate analysis of the civil and military statistics for the past thirty years, with a view to determining whether mental and nervous diseases have really increased to such an extent as statistics seem to show. His principal conclusions are as follows:—

(1) The main predisposing causes, alcoholism and syphilis, have been less prevalent of late years.

(2) The increase in the number of patients treated in establishments for mental diseases, and in the number of mentally deficient shown in census returns, are not really indications of a general increase in insanity and allied diseases. This increase is largely due to better diagnosis and greater facilities for institutional treatment.

(3) Intensive education appears to have lowered the power of resistance of the nervous system to deleterious influences, *e.g.*, alcohol and syphilis. During recent years Germany has rapidly become an industrial State instead of mainly an agricultural one, hence the increase in nervous disorders is more marked among her inhabitants than among those of neighbouring countries.

C. E. P.

Recruiting Statistics German Army for the Year 1911.—The following notes are taken from "*Ubersicht der Ergebnisse des Heeresergänzungsgeschäfts sowie eine Nachweisung über die Herkunft und Beschäftigung der Militärpflichtigen für das Jahr* 1911."

This document contains statistics with regard to the recruiting for the German army in the year 1911 as well as furnishing details concerning the place of birth (town or country) and occupation of the men, who in the year under review became liable to military service and were definitely assigned to one or other of the various categories.

The number borne on the recruiting list in 1911 was 1,271,384, which is an increase of 26,021 on the figures of the preceding year, which amounted to 1,245,363.

The number borne on the recruiting list was made up as follows:—

Men of 20 years of age	563,024
,, 21 ,, ...	367,688
,, 22 ,, ...	289,098
Men above 22 years of age	51,574

The following comparative table shows the classification of the numbers given above into the various categories during the years 1910 and 1911 respectively:—

	1910	1911	1910	1911
Numbers excluded from military service ..	890	826		
,, physically unfit	34,067	35,500		
,, posted to the "Landsturm" ..	144,737	142,307		
,, ,, ,, "Ersatz" Reserve ..	80,262	92,143		
			259,956	270,776
Contingent taken for the Standing Army—				
(*a*) Service with arms	201,530	207,741		
(*b*) ,, without arms	2,623	2,712		
	204,153	210,453		
Volunteers and men enlisted for special periods, such as schoolmasters	37,363	37,528		
Total for the Standing Army ..			241,516	247,981
Numbers posted to the Naval "Ersatz" Reserve	2,660	2,589		
Contingent taken for the Navy	12,156	13,472		
Volunteers for the Navy	2,287	4,916		
Total for the Navy			17,103	20,977
Number of men whose service was postponed, emigrants and excess numbers	..	..	726,478	731,650
Total	..	..	1,245,053	1,271,384

In addition to the above, the following enlisted as Volunteers :—

	1910	1911	1910	1911
In the Standing Army—				
One-year	13,145	13,582		
Schoolmasters	1,066	1,141		
Two-year	38,593	37,771		
Three-year	11,273	10,820		
			64,077	63,314
In the Navy	..	..	5,069	4,916
Total	..	..	69,146	68,230

The contingent taken compulsorily for the Army and Navy was made up as follows :—

	1910		1911
Men of 20 years of age	101,215	..	106,249
,, 21 ,, ...	53,228	..	53,185
,, 22 ,, ...	60,071	..	62,510
Men above 22 years of age	1,795	..	1,981
	216,309	..	223,925

Of the numbers taken compulsorily for the Army and Navy 138,722 were born in the country and 85,200 in the towns.

It will be observed that the numbers distributed among the various categories in the two years under review do not differ very materially.

There is a decrease in the number of volunteers in 1911, both for the Army and the Navy.

There is increase in the contingent taken compulsorily for the Army in 1911, which may be accounted for by the decrease in the number of volunteers and the additional numbers provided for by the "Friedens-präsenzstärke" (Peace strength) Law of March, 1911. The contingent taken for the Navy is also larger in 1911 than in 1910.

In 1911 the number posted to the "Landsturm" was smaller, and the number posted to the "Ersatz" Reserve larger than in the preceding year. If the years 1909 and 1910, however, are compared in this respect, the exact reverse will be found to have been the case.

C. E. P.

No. 6. June, 1913. Vol. XX.

J. Fotheringham.
Std.

Journal
OF THE
Royal Army Medical Corps

EDITED BY
COLONEL W. H. HORROCKS,
ROYAL ARMY MEDICAL CORPS

ASSISTED BY
MAJOR C. E. POLLOCK,
ROYAL ARMY MEDICAL CORPS

ISSUED MONTHLY

IN ARDUIS FIDELIS

Printed and Published by
JOHN BALE, SONS & DANIELSSON, LTD.
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PHYCITIDAE — PYRALIDINA — GALLERIADAE.

BRIT. MUS. (NAT. HIST.)

EPHESTIA KÜHNIELLA Zeller.

CORCYRA CEPHALONICA Stainton.

MOTH-INFESTED BISCUIT.

VOLUME XX. JUNE, 1913. No. 6.

Journal of the Royal Army Medical Corps.

Original Communications.

A PRELIMINARY REPORT OF THE TEMPERATURE REACHED IN ARMY BISCUITS DURING BAKING, ESPECIALLY WITH REFERENCE TO THE DESTRUCTION OF THE IMPORTED FLOUR-MOTH, *EPHESTIA KÜHNIELLA* Zeller.

By J. HARTLEY DURRANT, F.E.S., BRIT. MUS. (NAT. HIST.) * AND LIEUTENANT-COLONEL W. W. O. BEVERIDGE, D.S.O., R.A.M.C.

* **By permission of the Trustees of the British Museum, who have also lent Plates I, and III—VII.**

FOR some time past attention has been drawn to the fact that ration biscuits exported to the Colonies have become after a time quite unfit for consumption, owing to the ravages of certain moths and beetles—this has been specially noted in South Africa, Ceylon, Gibraltar, Malta, Mauritius, and the Sudan.

An enquiry has been undertaken to endeavour to ascertain :—

(1) How and when infestation of biscuit takes place;

(2) Whether any steps can be taken to avoid, or minimise, such infestation.

The insects met with during this enquiry are all widely distributed species whose range has doubtless been greatly extended by commerce—all occur in this country. The list is as follows :—

INJURIOUS INSECTS.

LEPIDOPTERA.

PYRALIDINA.

PHYCITIDAE.
EPHESTIA Guenée.
kühniella Zeller.
cautella Walker.
elutella Hübner.

GALLERIADAE.
CORCYRA Ragonot.
cephalonica Stainton.

COLEOPTERA.
BOSTRICHOIDEA.

ANOBIIDAE.
SITODREPA Thomson.
panicea Linné.

LASIODERMA Stephens.
serricorne Fabricius.

BOSTRICHIDAE.
RHIZOPERTHA Stephens.
dominica Fabricius.
= *pusilla* Fabricius.

PTINIDAE.
PTINUS Linné.
tectus Boieldieu.

CLAVICORNIA.

TROGOSITIDAE.
TENEBRIOIDES Piller.
mauritanicus Linné.

CUCUJIDAE.
SILVANUS Latreille.
surinamensis Linné.

DERMESTIDAE.
TROGODERMA Latreille.
sp. ?

HETEROMERA.

TENEBRIONIDAE.
TRIBOLIUM McLeay.
castaneum Herbst.
= **ferrugineum* Auctt. (nec Fabr.)
confusum Duval.

GNATHOCERUS Thunberg.
cornutus Fabricius.

RHYNCHOPHORA.

CURCULIONIDAE.
CALANDRA Clairville.
oryzae Linné.
granaria Linné.

BENEFICIAL INSECTS.

HYMENOPTERA.

BRACONIDAE.
BRACON Fabricius.
brevicornis Wesmael.
(Bred from pupae of *Ephestia elutella* Hübner.)

COLEOPTERA.

TROGOSITIDAE.
TENEBRIOIDES Piller.
mauritanicus Linné.
(Observed devouring *Tribolium castaneum* Herbst.)

All the above species were obtained from tins of biscuit, with the exception of *Ptinus tectus*, *Trogoderma sp.*, *Gnathocerus cornutus*, and *Calandra granaria*, which were found amongst loose material such as flour and grain, and may be expected to occur in the tins. It was noted that no traces of the moths *Pyralis farinalis* Linné, *Plodia interpunctella* Hübner, *Sitotroga cerealella* Olivière, or *Tinea granella* Linné, were found, and the beetles *Palorus melinus* Herbst, and *Latheticus oryzae* Waterhouse, have not yet been met with by us.

First, as to infestation:—Biscuit must become infested either (1) at home before packing, (2) during transit, or (3) in the country where stored. The biscuits are packed in tins, hermetically sealed, and enclosed in wooden cases to prevent injury; it was, therefore, obvious that if insects could be found within intact tins it would be demonstrated at once that infestment must have taken place in the factories, and not subsequently. With a view to determine the origin of infestation, sample tins were withdrawn from stocks at various stations abroad, for inspection at Woolwich by experts, and tins, which after careful examination had been pronounced intact, were found to contain *Ephestia kühniella, etc.*, in various stages of development; thus proving conclusively that infestion had taken place in the factories before the tins were soldered, and indicating that preventative or remedial measures must be undertaken in the factories themselves.

It is obvious, either that the heat acquired by biscuit in the process of baking is insufficient to destroy ova present in the moist dough, or that moths and beetles deposit their ova in or on the biscuits after baking, and during the process of cooling or packing in the tins. Cooling before packing is necessary, to allow the moisture in the centre of the biscuit to become evenly distributed throughout, and it is during the time occupied in cooling and packing that the biscuit is exposed to the greatest risk of infestation—any risk occasioned by subsequent injury to the case must be quite exceptional, and is probably unimportant.

The flour when received is often infested by insects in various stages, and the suggestion has been made that possibly the temperature reached during baking is not sufficient to sterilise the interior of the biscuit. What exactly occurs during the baking of the biscuit does not appear to have been accurately recorded, and some attempt has been made during this investigation to obtain an insight into the process.

In order to ascertain whether the heat within the biscuit during

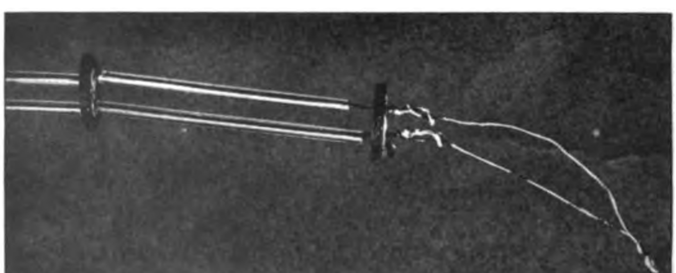
baking was of sufficient intensity to destroy the ova of these pests, it was necessary to determine the temperature actually reached in the interior of the biscuits during baking, and also the lowest temperature that would destroy the living ova within a reasonable time.

At the request of Brig.-General S. S. Long, Director of Supplies, we carried out some thermometric experiments at the factory of Messrs. Spillers and Bakers, at Bermondsey, who very kindly placed their ovens at our disposal, and their consulting chemist, Mr. F. G. Treharne, and Mr. R. Belfield, lent us every assistance.

Army Biscuits are made from dough containing about 25 per cent of water, and when stamped-out are immediately placed on the floor of an oven and baked in about 20 minutes while travelling a distance of about 40 feet. During baking the moisture is reduced to about 10 per cent and collects in the centre of the mass of the biscuit, in consequence of its external hardening, or caramelisation—the holes pricked in the biscuits enable them to part readily with excessive moisture. After cooling, the moisture distributes itself throughout the biscuit, and, as shown by analysis, then averages between 8 and 10 per cent. If the biscuits were packed immediately after baking, while hot, they would contain an excess of moisture and could not be supplied in accordance with specification.

To accurately determine the range of temperature within the biscuits, during their passage through the oven, it was necessary to employ some form of apparatus by which the actual temperature during the *whole* process of baking could be recorded. Ordinary thermometers, contact thermometers, fusible metals and other such-like devices cannot in general register accurate results, for although the maximum temperature reached in the biscuit can be determined by thermometers and contact thermometers, the range, distribution and variations cannot be recorded. Fusible alloys in the form of beads are not satisfactory for exact work, as they can only record a temperature corresponding to the melting point selected. The melting point itself cannot always be depended upon to give constant results, as the mass of metal, in contact thermometers and fusible metals, acts as a reservoir of heat and will not respond as rapidly as desired. It was necessary, therefore, in this case to use some form of instrument which would indicate only the heat of that portion of the biscuit with which it was in direct contact, and to ensure that other sources of external heat were entirely excluded. To meet these requirements a thermocouple was used in the present experiments. (*See* Plate II.)

RECORDING APPARATUS.



DETAILS OF THERMOCOUPLE.

DURRANT and BEVERIDGE: Report Army Biscuits

The apparatus consisted of:—

(1) *A Thermocouple.*—This was inserted into the centre of the biscuit at equal distance from either surface. It consisted of two wires, one of constantan, the other of copper, L.S.G., 0·30 in size, and about four inches long—these were soldered together at one end by means of silver solder. The free ends of the wire were in turn connected to thicker bare constantan and copper wires, 57 feet in length, which were insulated by glass tubes and mica discs, and again connected to copper and constantan wires made up into a flexible braided cable.

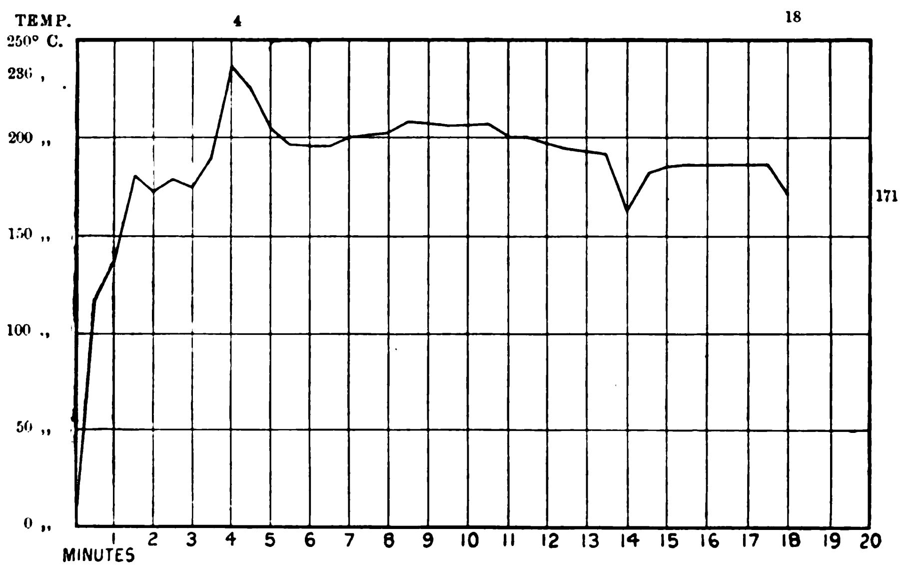
(2) *The Cold Junction.*—Nine inches of the approximate length of the constantan wire were left bare, and this length was soldered to a bare copper wire, thus constituting a cold junction. The first copper wire, and the copper wire soldered to the portion of constantan wire forming the cold junction, were again made-up into an insulated and braided cable, and led to the recording millivoltmeter, and, when in use, the cold junction was inserted into a thermos flask filled with melting ice, so as to maintain it at a constant temperature of 0° C.

(3) *A Millivoltmeter.*—This is a galvanometer, reading from zero to 250° C., and by means of a resistance or multiplying coil inserted in circuit, its range could be increased to 500° C. The readings from the scale of the millivoltmeter were recorded every half minute, during the passage of the biscuit through the oven, and also for some time afterwards, to show the continued rise until cooling set in. The instrument was calibrated to read correctly at 20° C., its temperature-coefficient being about 0·03 per cent, per degree C.—this error was practically negligible at the temperature at which the instrument was used, and an exact reading was therefore only necessary. The thermocouple being inserted into the biscuit, which was placed upon the floor of the travelling oven, the flexible cable was guided through by an assistant, the moment of exit being carefully noted at the far end. Other biscuits were being baked in the same oven, so that the conditions were precisely those of the ordinary daily process of baking.

During baking a certain proportion of the water contained in the biscuit is dissipated from the surface, which then becomes hard from caramelisation—the remainder of the water, being concentrated in a portion about the centre, rises to 100° C., or to a temperature little below that point.

On breaking open a biscuit, immediately after removal from the oven, steam issues and the centre is found to be soft and moist.

It would seem that when any reading exceeds 100° C., the temperature registered is that of the actual biscuit-structure and not of the contained steam, and that the biscuit-material, which is conveying heat to the water, must necessarily be of a higher temperature in order that heat may pass from it to the water—the caramel, or hardened portion of the biscuit, could of course acquire any temperature compatible with the surrounding heat by direct conduction.



TEMPERATURE OF OVEN.

In order to destroy the ova of insect pests the lowest temperature retained in any part of the biscuit must be regarded as the critical one, and in this case readings of not less than 100° C. were obtained in the centre of the biscuit. The experiments show that when the tip of the thermocouple lay within the moist area, or immediately adjacent to it, the temperature was only a little over 100° C., but when the tip, on the contrary, lay in the hardened portion, a much higher temperature was observed, in one case reaching as high as 125° C. It must be borne in mind that the temperature recorded in the later stages of the baking would probably be lower than the actual temperature attained in the biscuit, since the greater length of the wires connecting the thermocouple to the recording instrument would be in the oven, and consequently

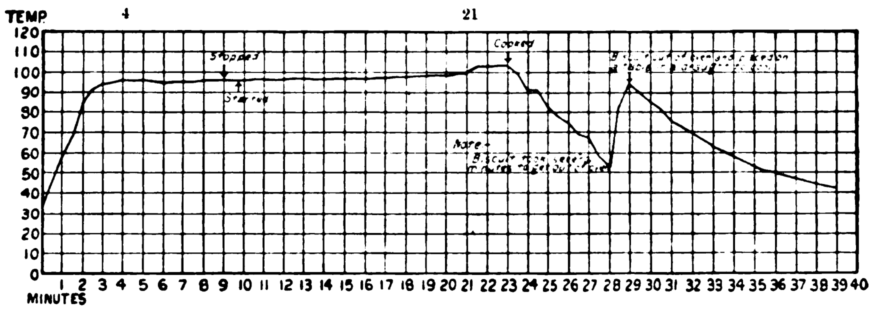
their temperature would be raised—this would result in an increase of their resistance, and a consequent decrease in the current flowing through them, thus giving a lower reading.

The temperature of the oven was determined beforehand, and the range is shown in the curve on p. 620.

The highest temperature recorded was 236° C. at the 4th minute, at the proximal end of the oven, while, after 18 minutes' baking, when a biscuit was removed at the other end of the oven 171° C. was registered.

Four experiments in all were carried out, and the range of temperature observed is shown by the curves in the diagrams.

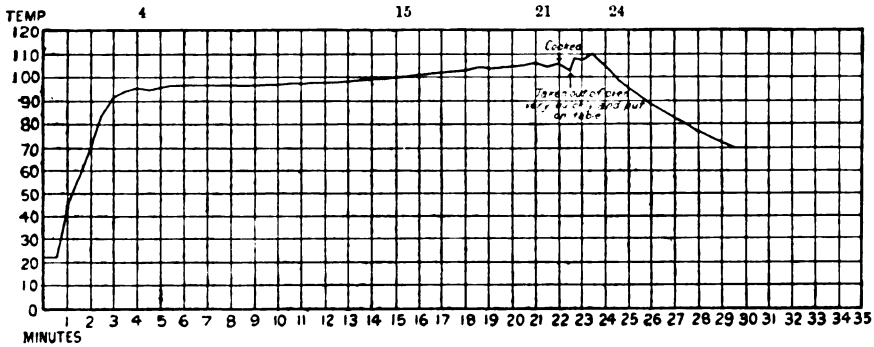
Experiment 1.—The temperature gradually rose to 95° C., at the 4th minute, and continued rising very slowly as the water in the biscuit was converted into vapour until it reached 100° C. at the 21st minute. There was then a rise of about 2°, followed by a gradual increase of temperature to 102·5° C. between the 22nd and 23rd minutes. On removal from the oven, the temperature of the biscuit fell and rose again (this was probably due to difficulties in manipulation when recovering the biscuit from the oven, but may also have been occasioned by draughts of cold air), and when the temperature had reached 93° C., gradual cooling set in.



EXPERIMENT 1.

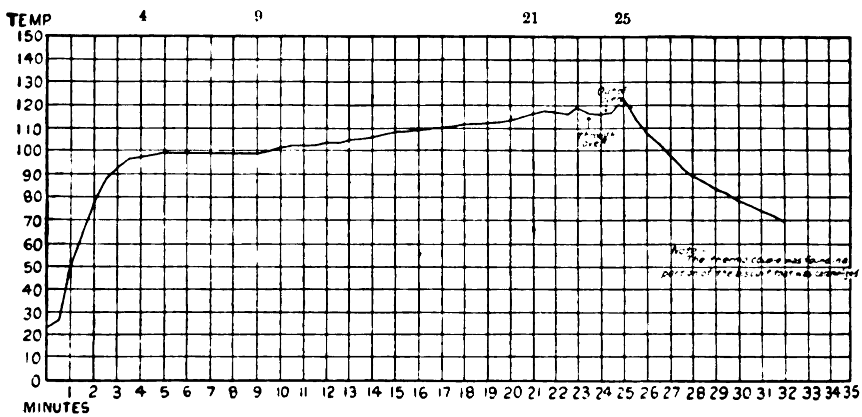
Experiment 2.—The temperature rose evenly until the 4th minute, when it reached 95° C., there was then a slow gradual rise in the temperature, due to vaporisation of moisture, until the 15th minute when 100° C. was recorded. The temperature continued to increase up to 105·75° C. at the 21st minute, when there was a slight variation before the biscuit was removed from the oven at between 22 and 22·5 minutes. A further rise of temperature took

place after the removal of the biscuit from the oven, 110° C. being registered between the 23rd and 24th minutes, the biscuit then cooling slowly.



EXPERIMENT 2.

In both experiments, Nos. 1 and 2, the thermocouple lay in the centre of the biscuit.

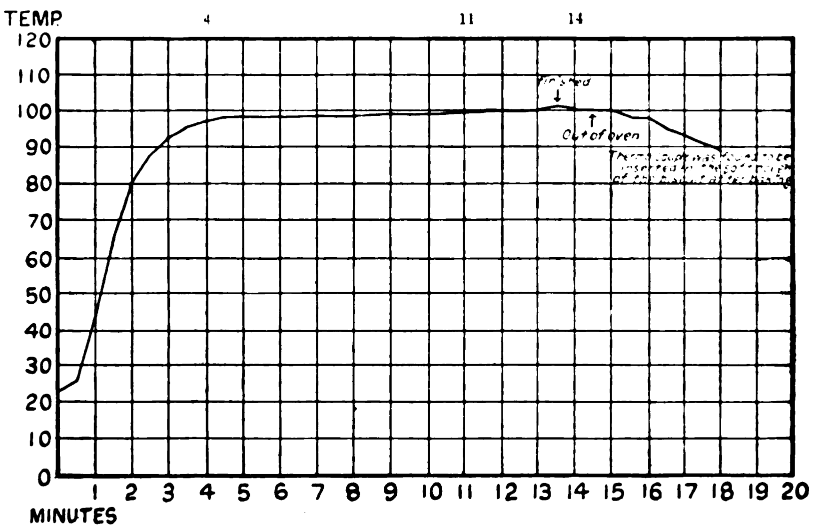


EXPERIMENT 3.

Experiment 3.—The thermocouple was nearer the surface and in the portion which was caramelised, 95° C. was reached between the 3rd and 4th minutes. At the 5th minute a temperature of 99° C. was registered and no change took place until the 9th minute, when a greater increase of temperature per unit of time was recorded, 100° C. being attained at 9·5 minutes. There was then a gradual increase in temperature until between the 21st and 22nd minute when 118° C. was recorded. After the biscuit was removed

from the oven at 24·5 minutes the temperature rose further to 124° C. at the 25th minute and then gradually fell.

Experiment 4.—The temperature was recorded in a special oven designed to bake the biscuit in 12 minutes at a higher temperature. Between the 3rd and 4th minutes 95° C. was reached, there was then a gradual further rise, due to the vaporisation of water, until a temperature of 100° C. was reached between the 11th and 12th minutes. The biscuit was baked between the 13th and 14th minutes, a temperature of 101° C. being recorded, and when removed from the oven at a temperature of 100° C. a gradual fall from that point was observed.



Experiment 4.

With regard to the second part of our inquiry:—The lowest temperature required to kill the ova of these insects can only be ascertained by experiment carried out in the laboratory.

A few preliminary observations have already been made to test methods of procedure and apparatus, and as ova become available during the warmer weather, batches will be exposed to different temperatures for varying lengths of time. Ova which have been exposed to a temperature of 69° C. for 12 minutes have failed to survive.

The experiments to record the temperatures occurring within the biscuits themselves have shown that by this process of baking,

a temperature of 95° C. is reached between the 3rd and 4th minutes of exposure, with a continued rise to 100° C. in the centre of the biscuit, or, in one case, to as much as 105° C., before the biscuit was removed at the end of the usual period of baking.

We are at present unable to state definitely the degree of heat necessary to kill the ova of insects, but we think it is very unlikely that these ova could withstand such temperatures as are reached and maintained during the process of baking.

We are also of opinion that infestation of the biscuits must take place after baking, during cooling, and prior to the tins being soldered.

We have considered the practicability of destroying insect life after packing, by puncturing the biscuit-tins before leaving the factory, raising the temperature to a lethal point and then finally soldering—there are technical difficulties, and also the question of added expense.

Until the temperature destructive to the ova of the moth *Ephestia kühniella* (which may be considered as also representing the other species) has been actually determined, the only practical suggestions we can offer are that the temperature conditions during cooling should be rendered as uncomfortable as possible for the moths, by introducing screened cooled air which should be continuously withdrawn by revolving fans, suction, or some similar contrivance. We think this would more rapidly cool the biscuit, and also render it practically impossible for the moth to oviposit on the biscuits.

Especial attention should be paid to prevent access of the moth to the places where the biscuits are cooled or packed.

We also suggest that the attention of the Board of Agriculture should be drawn to the advisability of protecting the Trade by scheduling *Ephestia kühniella*, *Corcyra cephalonica*, and perhaps other species also.

"Worms" in British Army Biscuits in 1801.—It would appear that insect pests have attacked our Army Biscuits for more than a hundred years, as shown by Serjeant Daniel Nicol, 92nd (Gordon) Highlanders, in his diary of his experiences during the expedition to Egypt under Lieut.-General Sir Ralph Abercromby. Writing of events in February, 1801, at Marmorice Bay, Asia Minor, where the British forces concentrated prior to setting sail for Alexandria, Serjeant Nicol writes :—

"Some vessels were despatched to Macri bay for bullocks and

others to Smyrna and Aleppo for bread which was furnished us by the Turks, a kind of hard dry husk. We were glad to get this as we were then put on full rations and our biscuits were bad and full of worms; many of our men COULD ONLY EAT THEM IN THE DARK!" ["With Napoleon at Waterloo," by Edward Bruce Low, edited by MacKenzie MacBride, p. 21 (London: Francis Griffiths, 34 Maiden Lane, Strand, W.C., 1911).]

When *Ephestia kühniella* was first observed damaging flour at Halle, in 1877, it was thought that it had been recently introduced by commerce from America, and even when notices began to appear about its introduction into England (1887-1889) it was still suggested that it came with American meal from Mediterranean ports—Trieste and Fiume are specially mentioned as the ports from which it reached London. In 1889 Miss E. A. Ormerod endeavoured to clear up this question of origin by submitting specimens to Professor C. V. Riley, of Washington, who replied: "I think I can safely say that this species does not occur in the United States." (*Insect Life* **1**. 315.) On the strength of this statement, the species, which had vaguely been termed "this pest of Mediterranean ports," gradually became known as "The Mediterranean Flour-moth," a name which perhaps would hardly have been applied to it had sufficient attention been called to a subsequent note by Professor Riley in *Insect Life*, vol **2**, pp. 166-7 (1889):—

"It will be remembered that in *Insect Life* for March (Vol. I., p. 315) we published a long letter from Miss Ormerod, in which she described the damage done by this pest in England, and that in our reply (*loc. cit.*) we stated that the species does not occur in the United States. In the hurry of getting ready to leave for Paris we allowed this statement to be made, notwithstanding the fact that we had in the National Museum collection for some time specimens of a moth indistinguishable from this species from A. W. Latimer, of Eufaula, Ala. On referring to our notes we find also that we had seen specimens from North Carolina in the collection of M. Ragonot in Paris. These facts undoubtedly prove the occurrence of the insect in North America for at least some years back. Up to the present time the species seems to have been rare here, for every case of serious damage to grain by Lepidopterous larvæ which has been carefully investigated has shown that the author of the damage was either the Angoumois Moth (*Gelechia cerealella*), the Grain Moth (*Tinea granella*) or

Ephestea interpunctella (=*zeæ* Fitch), a congeneric insect which was treated by Dr. Fitch under the common name of the 'Indian-meal Moth.'"

In the *American Naturalist* for February, 1890 (Vol. **24**, p. 200), Mr. J. J. Bell wrote:—

"**The Flour Moth.**—A new insect pest has recently made its appearance on the continent of America. It is known as the flour moth (*Ephestia kühniella*). . . . The flour moth is indigenous to the Mediterranean, and a few years ago it would have been likely to stay there. But increasing commerce has its attendant dangers. Experience has shown that as trade in the milling industry enlarges, weed and insect pests confined, at one time to a certain locality, have spread to places far distant. The flour moth has probably come to America with importations of seed wheat, or in bags in which flour has been exported, and which before their return may have been stored for a time in some place infested by the insect."

But *Ephestia kühniella* had been resident on the continent of North America for at least ten years when this was written!

In the Biologia Centrali-Americana [Insecta, Lep-Het. **2** p. 286 (1896)] the late Mr. Herbert Druce recorded *Ephestia kühniella* Z. from Guatemala, and also from Mexico and Guatemala, under the synonym "*gitonella* Ragonot, MS." as follows:—

"1. **Ephestia gitonella.**

Ephestia gitonella, Ragon. MS.

Hab. MEXICO, Ciudad in Durango 8100 feet, Milpas in Durango, 5900 feet (*Forrer*), Jalapa (*M. Trujillo*); GUATEMALA, Panajachel 5000 feet (*Champion*)."

"2. **Ephestia kühniella.**

Ephestia kühniella, Zell. Stett. ent. Zeit. 1879, p. 466[1]; Riley & Howard, Insect Life, ii. pp. 166-171[2].

Hab. NORTH AMERICA, Canada and United States.[2]—GUATEMALA, Panajachel 5000 feet (*Champion*).

One specimen, so named by Ragonot. The insect was described[1] from specimens found at Halle, but it was supposed to have been introduced from North America in the larval state in meal. It is a destructive pest in the United States and Canada, as well as in Europe." [Druce Biol. C-Am. Ins. Lp-Het. 286 (III. 1896).]

Two of these records are important and the data can now be given more exactly:

GUATEMALA: SOLOLA: Panajachel, 5000 ft., 30 December 1880 (*G. C. Champion*).

Mr. Champion has kindly given the following additional information: "The house I stayed in at Panajachel was a flour-mill, on the banks of the Lake of Atitlan, some distance from the village. The wheat ground there is all grown in the district. G. C. C., 1. IV. 1913."

MEXICO: DURANGO: Ciudad, 8100 ft., and Milpas, 5900 ft., [June to September] 1881 (*A. Forrer*).

It now becomes manifest that the *so-called* "Mediterranean" Flour-moth, which was first observed in Europe, at Halle in 1877, was resident in Guatemala in 1880, in Mexico in 1881, and that it occurred in Alabama (at Eufaula, *A. W. Latimer*), and North Carolina (probably 1883, *H. K. Morrison*) before it reached England or Canada.

It would seem fair to infer that *Ephestia kühniella* extended its range from Central America through the Southern States northward, and perhaps reached Europe from a southern port (such as New Orleans) before its depredations had been observed and recorded in the United States. Certainly one would expect the moth to travel with the grain trade toward Europe, rather than (as suggested) in empty bags, or sacks, in the opposite direction!

The following exact data with reference to the duration of life of *Ephestia kühniella* Zeller, were obtained for us by careful observation by Mr. Herbert Stringer, during 1912, in the British Museum (Nat. Hist.).

Egg laid	Larva hatched	Food	Pupated	Moth emerged	Under observation	Average temperature (F.)	Extremes of temperature (F.)
						°	° ° °
4.I	18.I	Rice flour ..	11.V	28.V	= 22 weeks ..	62	58–64
23.II	5.III	Biscuit ..	12.VIII	27.VIII	= 26 weeks ..	63	58–67
—	5.III	Wholemeal flour	17.VII	12.VIII	= 23 weeks ..	63	61–67
—	24.IV	Biscuit ..	11.IX	3.X	= 23 weeks 1 day	63	64–67–63
22.IV	4.V	,, ..	10.IX	30.IX	= 22 weeks ..	63	64–61
17.V	2.VI	,, ..	19.X	11.XI	= 26 weeks 4 days	63	64–67–62
8.VI	17.VI	,, ..	18.X	18.XI	= 23 weeks 5 days	63	64–67–62
—	17.VI	,, ..	9.X	14.X	= 17 weeks 2 days	63	64–67–63

Average Duration.

Egg to Larva	14 days =	2 weeks.
Larva to Pupa	128 days =	18 weeks 2 days.
Pupa to Imago	16 days =	2 weeks 2 days
Egg to Imago	158 days =	22 weeks 4 days.

Mr. F. W. Chittenden [US. Dept. Agr. (Div. Ent.) Bull. **6** (n.s.) 85-8 (1896)] shows that at an average temperature of about 82° F. at Washington, the period from egg to moth may be as short as thirty-eight days, as contrasted with Mr. W. G. Johnson's period of fifty-nine days in California and Illinois, and M. Danysz' period of about two months in France.

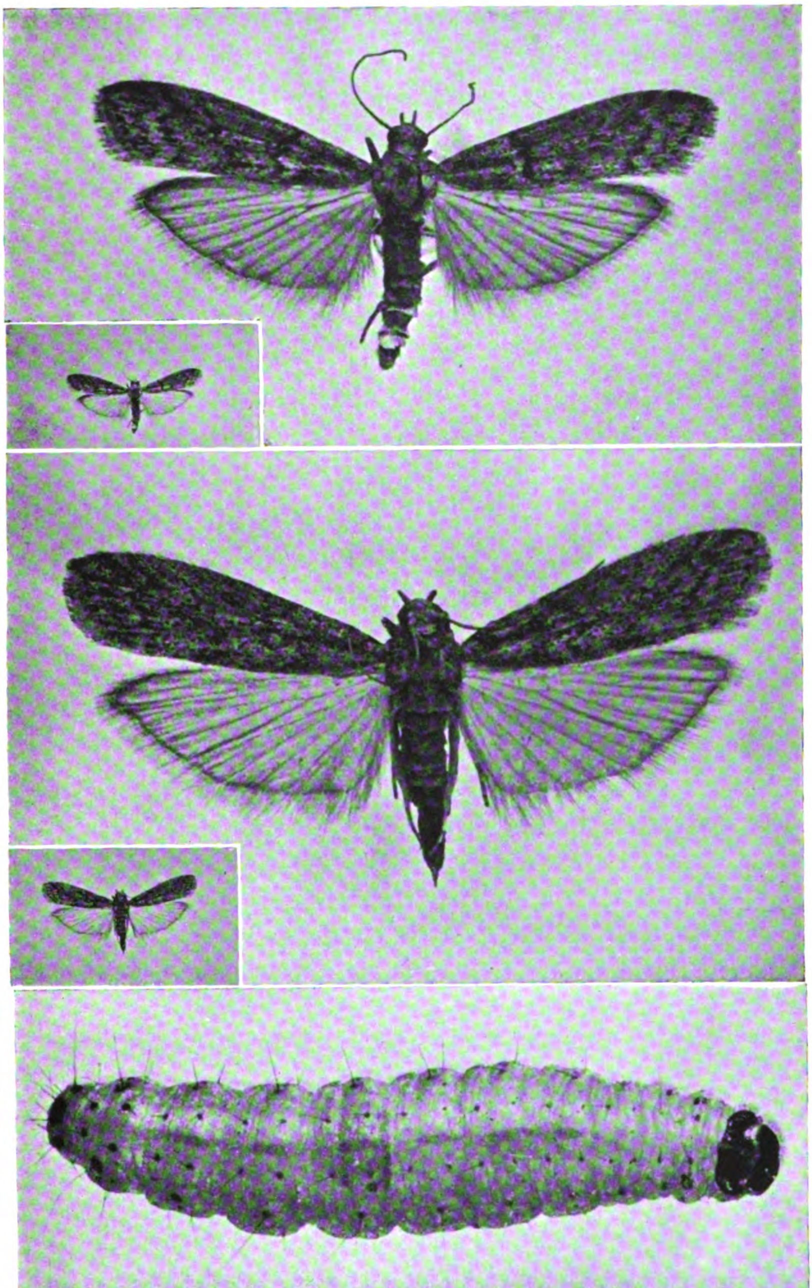
It is only too apparent from these data how rapidly destruction of the contents of an infested case of biscuit will be accelerated by removal to a hot climate.

The species of Lepidoptera which most seriously infest Army Biscuit are *Ephestia kühniella* Z., and *Corcyra cephalonica* Stn., but *Ephestia elutella* Hb., and *Ephestia cautella* Wkr., have been found almost equally destructive to some samples. It would seem that *Corcyra cephalonica* is a less serious pest than the *Ephestiae*, for if the percentage of moisture present in the biscuit be considerably reduced, the young larvae of the *Corcyra* are unable to bite the dry biscuit, and die of starvation—this has not been found to be the case with the *Ephestiae*.

Apart from shape and general appearance the *Corcyra* will be easily distinguished by the projecting tufts on the head, and by the long projecting palpi of the female. The palpi appear to be absent in the male, but are in reality appressed to the face and concealed in dense scaling—the *Ephestiae*, on the other hand, have distinct ascending palpi in both sexes. These differences are clearly shown by the figures, as also the different arrangement of veins in the wings, which renders it a matter of no great difficulty to determine the genus from dead and badly worn specimens—generic determination is easy if the wings are placed on a glass slide and moistened with alcohol, when the scales may be removed by an ordinary camel-hair pencil.

Ephestia kühniella may be briefly described as a pale slaty grey species, with an outwardly oblique, indented, dark fuscous, or blackish transverse line at one-third, and another, strongly indented inwardly, before the end of the wing, the first preceded, and the second followed by a more or less clearly indicated pale line; between these fasciae, beyond the middle of the wing, are two blackish discal dots, one above the other, and sometimes with some dark scales above and below them; the hindwings are conspicuously whitish. The Larva of *kühniella* is rather stout, sometimes whitish, but generally with a pinkish tint; the head is shining, chitinous brownish, or honey brownish, or even paler; the pronotal and anal plates are somewhat paler than the head; spots

PYRALIDINA—PHYCITIDAE.



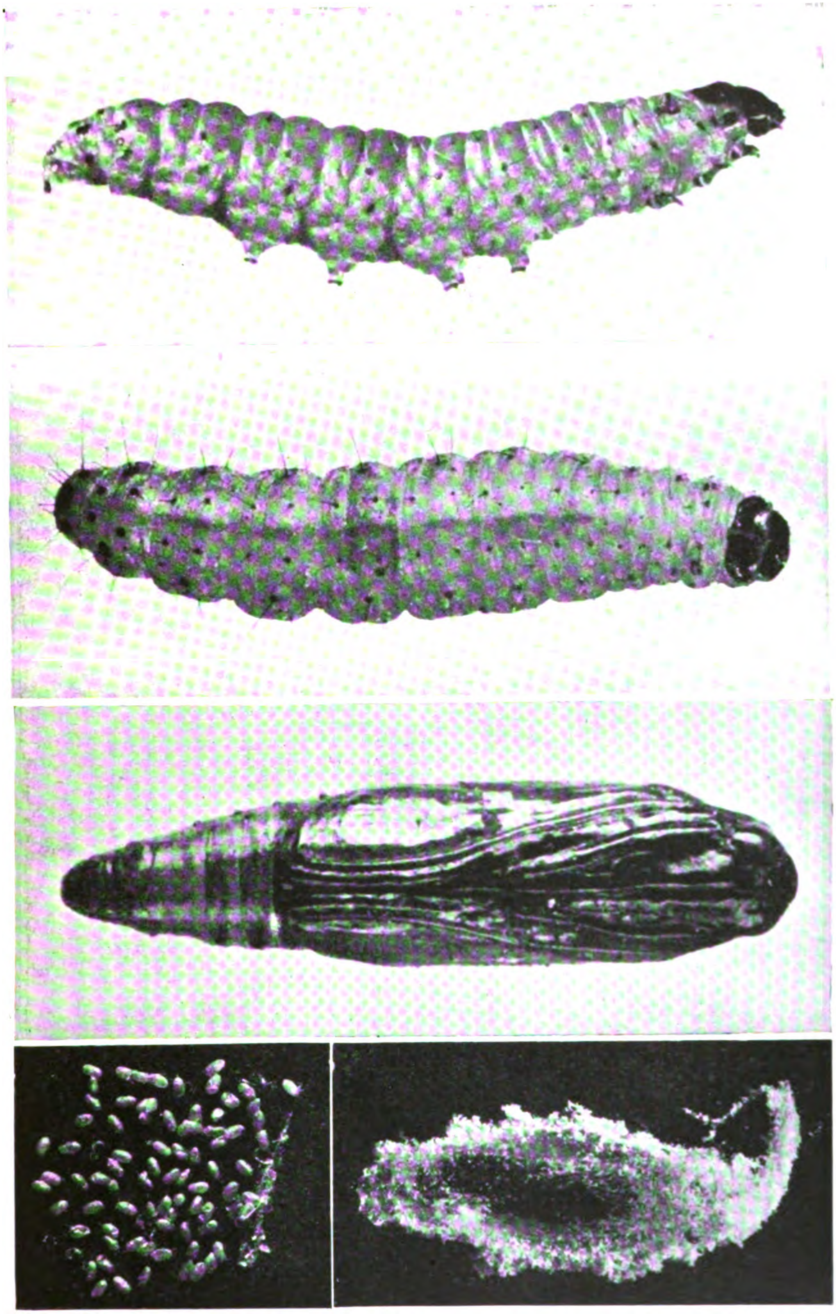
BRIT. MUS. (NAT. HIST.)

EPHESTIA KÜHNIELLA Zeller.

(Male and Female, natural size, and enlarged; Larva, enlarged.)

DURRANT and BEVERIDGE: Report Army Biscuits.

PYRALIDINA—PHYCITIDAE.



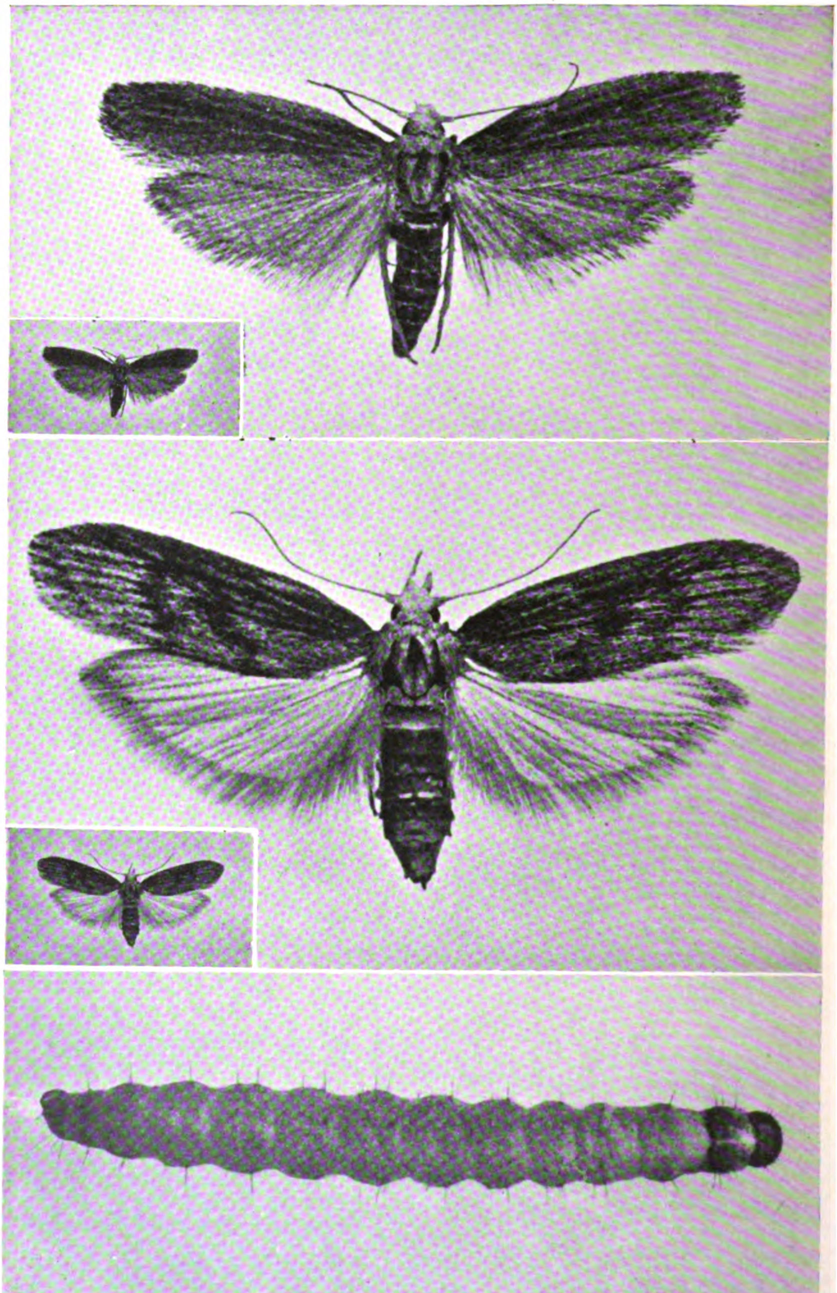
BRIT. MUS. (NAT. HIST.)

EPHESTIA KÜHNIELLA Zeller.

(Larva, lateral, and dorsal; Pupa ventral; Cocoon; Ova—much enlarged.)

DURRANT and BEVERIDGE: Report Army Biscuits.

PYRALIDINA--GALLERIADAE.



CORCYRA CEPHALONICA Stainton.

(Male and Female, natural size, and enlarged; Larva, enlarged.)

DURRANT and BEVERIDGE: Report Army Biscuits.

distinct, with long fine hairs. Pupa shining, fuliginous, enclosed in whitish silken cocoon.

Corcyra cephalonica may be briefly described as smoky fuscous, pale fuscous, whitish fuscous, or ochraceous, apparently all darker or paler tones of the same colour, when darker markings are present these tend to arrange themselves longitudinally in the direction of the veins, the dorsal margin is always of the pale ground-colour; sometimes two irregular, dentate, darker transverse lines are present (this is the form described as *translineella* Ragonot); the hindwings are fuscous in the male, whitish fuscous in the female; the head and the basal joint of the antennae are distinctly tufted with long scales, and are of a paler colour than the wings. The Larva of *cephalonica* is dull whitish, the spots inconspicuous, but indicated by long fine hairs; the head is shining, pitchy, or honey brownish; pronotal plates slightly paler, the anal plate small, still paler. The yellowish olivaceous pupa is enclosed in a somewhat dense silky whitish cocoon.

PYRALIDINA.

PHYCITIDAE.

EPHESTIA Guenée.

= Cadra Walker.

Type 1: **Tinea elutella** Hübner (HS. 1849; Hulst 1890).

EPHESTIA Guenée Ann. Soc. Ent. France **14** (**2 s. 3:1845**) 319-20 no.17 (1845): Eur. Microlep. Ind. Meth. 81-2 no.17 (1845); Zeller Isis **41:1848** 585, 592-9 no.2 sp.1-7 (1848); Herrich-Schäffer SB. Schmett. Eur. **4** 84, 110 no.38 sp.357-9 (1849); Stainton Man. Brit. B.&M. **2** 167, 168-9, 457 no.2 sp.862-5 (1859); Heinemann Schmett. Deutsch. Pyral. 201-2 no.370 sp.294-5, Tbl. 4, 27 no.370 (1865); Walker Cat. Lep. Brit. Mus. **27** 23-4 no.3 sp.1-16 (1863): **30** 957 (1864): **35** 1708 (1866); Staudinger-Wocke Cat. Lep. Eur. 230-1 no.94 sp.633-41 (1871); Meyrick Proc. Linn. Soc. NSW. **3** 215-6 (1879): **4** 234-5 (1879): **7** 160 no.19 (1882); Ragonot Diagn. N-Am. Phyc-Gall. 17 sp.78-9 (1887): Nouv. Gen. et Sp. Phyc-Gall. 36 sp.151-3 (1888); Hulst Tr. Am. Ent. Soc. **17** 197-200 sp.1-5, 226 no.49 sp.162-6 (1890); Meyrick HB. Brit. Lep. 362, 372-4 no.12 sp.1-5, tf. (1895); Druce Biol. Centrali-Americana Ins. Lep-Het. **2** 286-7 sp.1-6 (1896); Hampson Fauna Brit-Ind. **4** 64, 66 no.2 sp.4317-8, tf. 66·44 (1896); Ragonot-Hampson,

Romanoff's Mem. Lep. **7** Pf. **2**·19-21, **8**·18 (1893): **8** pp. xiii, 271-304 sp. 408-49 Pf. **34**·13-25, **35**·3-15, **36**·1,·3-4, **42**·19, **49**·10,·17-18 (1901). Staudinger-Rebel Cat. Lp. Pal. **2** 15-16 no.42 sp.254-88, 257 sp.266 bis (1901); Hulst Bull. US. Nat. Mus. **52** 434-5 sp.4873-9 (1902); Turner Proc. Roy. Soc. Queensl. **18** 123, 124 No. 12 (1904).

Type 2: **Pempelia cautella** Walker (= *defectella* Walker; Wkr. 1864).

CADRA Walker Cat. Lep. Brit. Mus. **30** 961-2 sp.1 (1864).

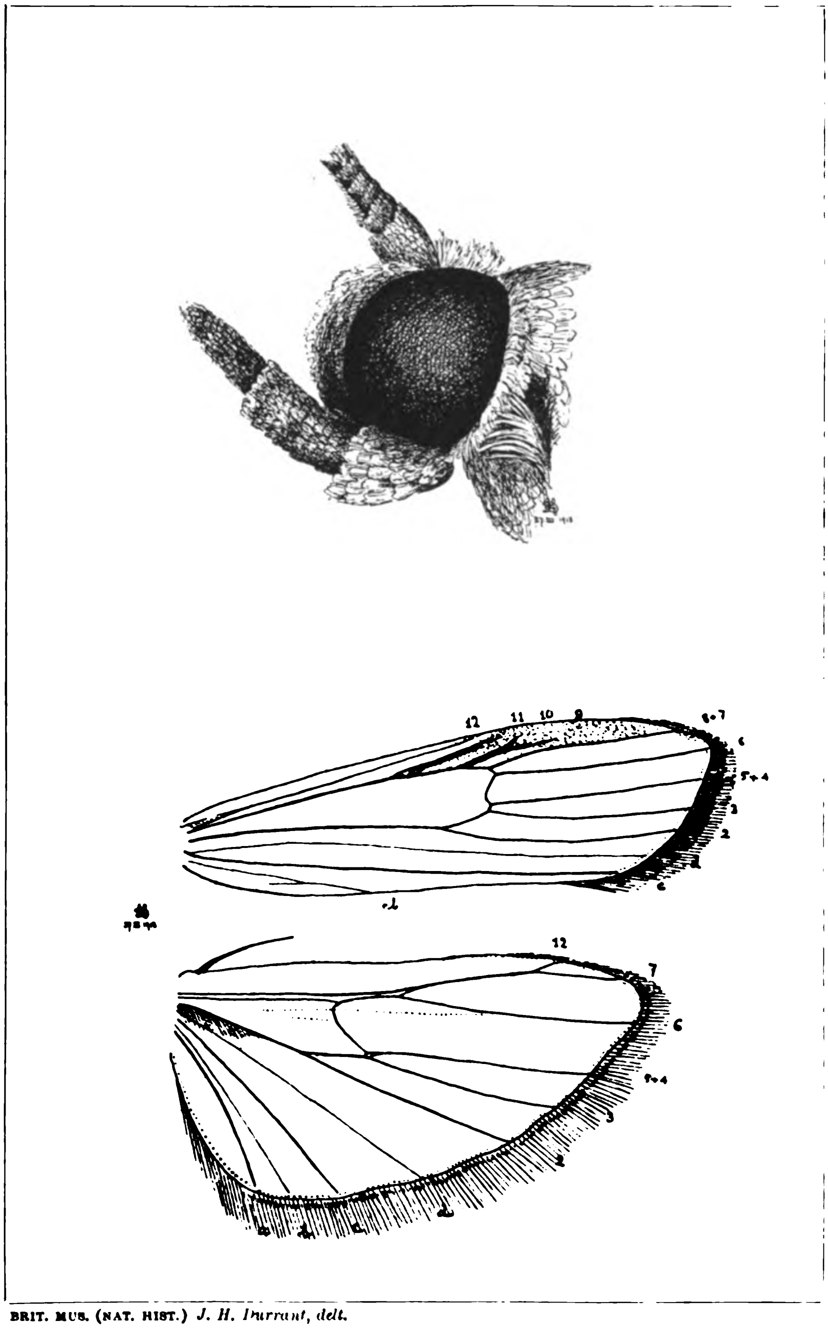
Antennae very shortly ciliate. *Maxillary Palpi* moderate, filiform. *Labial Palpi* moderately long, curved, ascending, clothed with somewhat large appressed scales. *Haustellum* well-developed. *Head* with appressed scales; face smooth. *Thorax* with appressed scales. *Forewings* elongate, somewhat narrow: *neuration* 10 veins, (4-5 coincident, 7-8 coincident); 9-10 stalked, becoming obsolescent in the costal stigma which also affects 11; 3 and 5 approximate toward base. *Hindwings* broader than the forewings: *neuration* 7 veins (4-5 coincident); 6-7 stalked, 12 anastomosing with 7 from near its furcation to near costa where 7-12 appear furcate; 3-5 very closely approximate, connate, [or stalked] (4 and 3 probably stalked, 4 immediately becoming coincident with 5). *Abdomen* with appressed scales. *Legs:* hind tibiae smooth.

Ephestia kühniella Zeller.

(† *kuhmiella* Poulton; † *kurhuirela* Johnson; † *lunella,* Noel); =*gitonella* (Ragonot MS.) Druce.

Ephestia kühniella Zeller Ent. Zeit. Stettin **40** 466-71 (1879); Snellen Tijd. Ent. **24:1880-1** pp. xx-xxi (1880); Preudhomme de Borre CR. Soc. Ent. Belg. **28** pp. ccxi, ccxxxvi-vii (1884); Karsch Ent. Nachr. **10** 109-12, 266 (1884): **11** 46-7 (1885); Girard Bull. Soc. Ent. France **53** (**6 s. 4:1884**) p. lxxiii (1884); Ragonot Bull. Soc. Ent. France **53** (**6 s. 4:1884**) pp. lxxiii-iv (1884); Snellen Tijd. Ent. **28:1884-5** 237-51 Pf. **8**·1-17 (1885). **Myclois ceratoniae* (*nec* Zeller) Thompson Ent. **20** 66 (1877). *Ephestia kühniella* Barrett Ent. Mo. Mag. **23** 255-6 (1887); Thompson Ent. **20** 139 (1887); Tutt Ent. **20** 212 (1887); Klein Proc. Ent. Soc. **1887** pp. lii-iv (1887); Adkin Proc. S. London Ent. & NH. Soc. **1887** 20, 58 Pf. **1**·15 (1888). †*Ephestia kühmiella* Poulton Trans. Ent. Soc. Lond. **1888** 599, 606 Pf. **17**·9-10 (1888). *Ephestia kühniella* Ormerod US. Dept. Agr. (Div; Ent.) Ins. Life **1** 314-5 (1889); Riley US. Dept. Agr. (Div. Ent.) Ins. Life **1** 315 (1889); Ormerod Report Inj. Ins. **12:1888** 56, 66-72, 127-8 (1889): **13:1889** 49-54 tf. (1890): **14:1890** 52-60 tf. (1891): **15:1891** 46-52 tf. (1892): **16:1892** p. v. (1893): **20:1896** 103-6 tf. (1897): **21:1897** 95-101 tf. (1898): **23:1899** 54-6, 76-92 tf. (1900);

PYRALIDINA--PHYCITIDAE.



BRIT. MUS. (NAT. HIST.) *J. H. Durrant, delt.*

EPHESTIA KÜHNIELLA Zeller.

(Head and Neuration, much enlarged.)

DURRANT and BEVERIDGE: Report Army Biscuits.

Riley-Howard US. Dept. Agr. (Div. Ent.) Ins. Life **2** 166-71 tf. 28-9 (1889); Fletcher US. Dept. Agr. (Div. Ent.) Ins. Life **2** 187-9 (1889); Bell Amer. Nat. **24** 200-4 tff. (1890); Fletcher Rep. Ent. Soc. Ontario **20:1889** 95-101 tf. 98·49 (1890); Can. Ent. **22** 41-4 tf. (1890); South Ent. **23** 329-30 Pf. **4**·8 (1890); Hulst Trans. Am. Ent. Soc. **17** 198-200 sp.3, 226 sp.164 (1890); Riley-Howard US. Dept. Agr. (Div. Ent.) Ins. Life **3** 134-5 (1890). **Ephestia interpunctella* (*kühniella*) Patton US. Dept. Agr. (Div. Ent.) Ins. Life **3** 158·9 (1890). *Ephestia kühniella* Riley-Howard US. Dept. Agr. (Div. Ent.) Ins. Life **5** 141, 276, 290, 350, 353-4 (1892-3); Danysz Bull. Soc. Ent. France **1893** pp. clxxviii-clxxxi (1893): [Danysz Mém. Lab. Parasit-Végét. **1** 1-60 (1893)]; Riley-Howard US. Dept. Agr. (Div. Ent.) Ins. Life **6** 44-5, 221-2, 335 (1893-4); Chittenden YB. US. Dept. Agr. **1894** 283-5 tf. 46 (1895); Howard US. Dept. Agr. (Div. Ent.) Ins. Life **7** 416 (1895); Decaux Bull. Soc. Ent. Fr. **1893** pp. clxxxviii-ix (1893). † *Epheitia kurhuirela* Johnson Ent. News **6** 324-5 (1895). *Ephestia kühniella* Meyrick HB. Brit. Lep. 372, 374 sp.5 (1895); Chittenden US. Dept. Agr. (Div. Ent.) Bull. **6 (n.s.)** 85-8 (1896). *Ephestia gitonella* (Ragonot MS.) Druce Biol. Central-Amer. Ins. Lep-Het. **2** 286 sp.1 (1896). *Ephestia kühniella* Druce Biol. Central-Amer. Ins. Lep-Het. **2** 286 sp.2 (1896); Johnson Ent. News **7** 106 (1896): Rep. Ent. Illinois **19** App. 1-70 (1896); Chittenden US. Dept. Agr. (Div. Ent.) Bull. **8 (n.s.)** 38-41 (1897); Ragonot-Hampson, Romanoff's Mém. Lep. **7** Pf. **2**·19 (1893): **8** 272, 279 sp.410 (1901); Staudinger-Rebel Cat. Lep. Pal. **2** 15 sp.254 (1901); Hulst Bull. US. Nat. Mus. **52** 435 sp.4874 (1902). † *Ephectia lunella* Noel Le Nat. **26 (2 s. 18)** 82-3 (1904). *Ephestia kühniella* Noel LeNat. **26 (2 s. 18)** 104 (1904): **29 (2 s. 21)** 32-3 (1907); Barrett Lep. Brit. Is. **10** 54-6 Pf. **430**·5·5a (1905); Chittenden US. Dept. Agr. Circular **112** 1-22 tf.1-5 (1909).

Antennæ dark fuscous. *Palpi* curved, ascending, clothed with appressed scales; fuscous, tipped with whitish. *Head* and *Thorax* fuscous, irrorate with whitish, appearing dark greyish. *Forewings* narrow, elongate, costa somewhat straight from the base, becoming gradually convex from about two-thirds; pale fuscous, speckled with dark fuscous or blackish scales—the pale fuscous scales being each tipped with white cause the ground colour to appear pale ash-grey, or grey irrorate with whitish; the blackish scales tend to arrange themselves conspicuously along the edges of the pale transverse lines (which are only distinguishable from the ground-colour by their edging of dark scales), and less conspicuously along the veins; the *first* line, near the end of the basal third, running obliquely outward from costa to dorsum, conspicuously dark-edged posteriorly, and indented below the costa, in the cell, and on the fold; the *second* line, within the outer third, much more distinctly dark-edged anteriorly than posteriorly, strongly dentate

below the costa and again less strongly on the fold, the intervening part sinuate and indented; discoidal spots blackish, distinct, but often somewhat obscured by dark scaling above or below, the upper spot slightly beyond the lower; costa darkened at the base, the basal patch more or less indicated by dark scaling; subterminal line indistinct, followed by blackish dentate spots along the termen; cilia pale fuscous, darker towards their base, tipped with whitish, and with two or three inconspicuous whitish lines running through them. *Exp. al.* 17-23 mm. *Hindwings* nearly twice as broad as the forewings; shining, very pale fuscous, almost whitish, darker toward the termen and costa; cilia pale whitish fuscous, with a slightly darker line along their base. *Abdomen* fuscous, somites posteriorly edged with whitish. *Legs* fuscous, irrorate with whitish, tarsi darker except at the ends of the joints.

Hab. America, C-N.; Europe, Asia, Africa—imported with flour, meal, grain, biscuits, &c.

The following Parasitic Hymenoptera have been bred from *Ephestia kühniella* Z.:—

BRACONIDAE

Chremylus Haliday.

Chremylus rubiginosus Nees (*teste* Bridgman; Europe). Riley-Howard US. Dept. Agr. (Div. Ent.) Ins. Life **2** 260 (1890); Johnson Ent. News **6** 324 (1895); Chittenden US. Dept. Agr. (Div. Ent.) Bull. **8** **(n.s.)** 39-41 (1897).

Bracon Fabricius.

Bracon brevicornis Wesmael (*teste* Geikie; Europe). Billups Proc. Ent. Soc. Lond. **1888** pp. xxviii-ix (1888); Riley-Howard US. Dept. Agr. (Div. Ent.) Ins. Life **6** 44-5 (1893); Johnson Ent. News **6** 324-5 (1895); Chittenden US. Dept. Agr. (Div. Ent.) Bull. **8** **(n.s.)** 39-40 (1897).
Three specimens (♂ ♀ ♀) bred in the British Museum (Nat. Hist.) 27. VIII. 1912, from larvae of *Ephestia elutella* Hübner, infesting Army Biscuit.

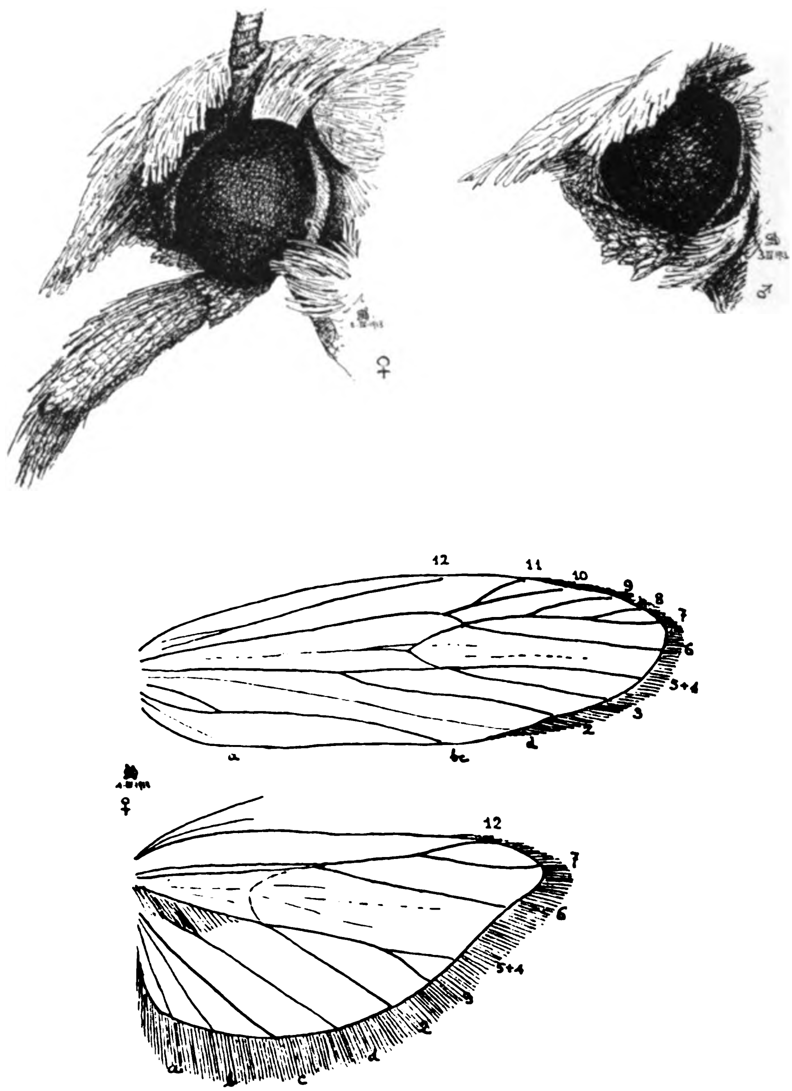
Bracon Fabricius (Habrobracon Johnson).

Bracon (*Habrobracon*) *hebetor* Say (*teste* Johnson; California). Johnson Ent. News **6** 324-5 (1895); Chittenden US. Dept. Agr. (Div. Ent.) Bull. **8** **(n.s.)** 38-40 tf. 10 (1897).

Apanteles Förster.

Apanteles ephestiae Baker (*teste* Baker; Colorado). Baker Ent. News **6** 201-2 (1895); Chittenden US. Dept. Agr. (Div. Ent.) Bull. **8** **(n.s.)** 41 (1897).

PYRALIDINA—GALLERIADAE.



BRIT. MUS. (NAT. HIST.) *J. H. Durrant, delt.*

CORCYRA CEPHALONICA Stainton.

(Head, female ♀, male ♂, and Neuration, much enlarged.)

DURRANT and BEVERIDGE: Report Army Biscuits.

This species is described as bred "in the Entomological Laboratory of the Colorado Agricultural College . . . . from the larvae of *Ephestia kühniella* working in honeycomb."!

GALLERIADAE.

CORCYRA Ragonot.

Type: **Melissoblaptes cephalonica** Stainton (Ragonot 1885);

CORCYRA Ragonot Ent. Mo. Mag. **22** 22-3, 58 sp.50 (1885); Meyrick HB. Brit. Lep. 383, 384 no.2 sp.1 (1895); Ragonot-Hampson, Romanoff's Mem. Lep. **7** Pf. **1**·34, **3**·18 (1893): **8** pp. xxviii, xl, 491-3 sp.80-1 Pf. **45**·23, **51**·26 (1901); Staudinger-Rebel Cat. Lep. Pal. **2** 1 no.2 sp.2 (1901); Barrett Lep. Brit. Is. **10** 147-50 no.4 sp.1 Pf. **443**·1, 1[a-c] (1904); Turner Proc. Roy. Soc. Queensl. **18** 154-5 no.1 (1904).

Antennae: basal joint with large shield of scales. *Maxillary Palpi* present. *Labial Palpi:* ♂ short, ascending, concealed in dense scales; ♀ long, porrect, clothed with appressed scales, and with some long hair-scales intermixed. *Haustellum* rudimentary. *Head* with projecting tuft of hair-scales. *Thorax* smooth. *Forewings* elongate, costa evenly convex, apex slightly depressed, termen obliquely rounded: *neuration* 11 veins (4-5 coincident); 7-8 stalked, 9 out of their stalk; 10-11 stalked; 3 and (4 + 5) short-stalked; 1^{bc} basally furcate. *Hindwings* elongate, but broader and shorter than the forewings, slightly sinuate beneath apex: *neuration* 7 veins (4-5 coincident); 6-7 stalked, 12 anastomosing with 7 from immediately beyond its furcation to beyond its middle; 3 and (4 + 5) long-stalked, 2-3 connate; discoidal subobsolete. *Abdomen* and *Legs* smooth.

Corcyra cephalonica Stainton.

=*oeconomellus* Mann; **n. syn.** = *translineella* Ragonot-Hampson.

Melissoblaptes ? cephalonica Stainton Ent. Mo. Mag. **2** 172-3 (1866); Stainton-Knaggs Ent. Ann. **1866** 147-9 (1866); Staudinger-Wocke Cat. Lep. Eur. 425 sp.646[bis] (1871). *Melissoblaptes oeconomellus* Mann Verh. ZB. Ges. Wien **22:1872** Abh 35-6 (1872); Staudinger Hor. Soc. Ent. Ross. **15:1879** 231-2 (1879). *Corcyra cephalonica* Ragonot Ent. Mo. Mag. **22** 22-3, 58 sp.50 (1885). *Melissoblaptes cephalonica* Leach Brit. Pyr. 110, 114 Pf. **13**·5 (1886); South Ent. **23** 336-7 Pf. **4**·3 (1890). *Corcyra cephalonica* Meyr. HB. Brit. Lep. 384 sp.1 (1895); Ragonot, Romanoff's Mém. Lep. **7** Pf. **1**·34, **3**·18 (1893): **8** pp. xxviii, xl, 491-2 sp.80 Pf. **45**·23 (1901). *Corcyra translineella* Ragonot-Hampson, Romanoff's Mém. Lep. **8** 491, 492-3 sp.2 Pf. **51**·26 (1901). *Corcyra cephalonica*, Staudinger-Rebel Cat. Lep. Pal.

2 1 sp.2 (1901); Barrett Lep. Br. Is. **10** 147-50 sp.1 Pf. **443**·1, 1[a-c] (1904); Fletcher Trans. Linn. Soc. Lond. (**2 s.**) Zool. **13** 296, 316 sp.94 (1910).

Antennae whitish fuscous; basal joint with some darker fuscous scales. *Head* and *Thorax* very pale fuscous, sometimes whitish fuscous, or darker fuscous. *Forewings* very pale fuscous, the veins more or less indicated by darker fuscous scaling, and with a tendency to suffusion over the whole wing, except along the dorsum which remains of the pale ground-colour; in some specimens the darker markings are almost absent, in others there is a tendency to form two irregular transverse dark lines, one at the end of the cell, the other at about half the wing-length, with some dark shading towards the base; a more or less distinct dark spot occurs on the margin at the end of each vein; cilia pale fuscous, with some admixture of darker scales. *Exp. al.* 14—24 mm. *Hindwings*, ♂ fuscous; ♀ shining whitish fuscous; cilia with a slightly paler line at their base. *Abdomen* and *Legs* pale fuscous.

Hab. EUROPE-ASIA: Mediterranean, (England, and Germany—imported), India, Ceylon, Cocos-Keeling Is., Christmas Id., Kei Is., *etc.*—AFRICA: Sudan, W., Nyasaland, La Réunion.—AMERICA, S-I.: Brazil (Pará); Cuba, Grenada.

This would appear to be a species of Eastern origin, introduced into Europe, and elsewhere, by the rice-trade; it was thought to be specially attached to currants, but it is imported to this country freely with Rangoon rice which seems to be its natural food; there seems little doubt that anything that will satisfy an *Ephestia* will be equally nourishing to *Corcyra*.

THE CAUSATION AND PREVENTION OF ENTERIC FEVER IN MILITARY SERVICE.

WITH SPECIAL REFERENCE TO THE IMPORTANCE OF CARRIERS.[1]

BY MAJOR S. L. CUMMINS.
Royal Army Medical Corps.

PART I. CAUSATION OF ENTERIC FEVER BY CARRIERS.

IN his preface to Dr. J. C. G. Ledingham's "Report to the Local Government Board on the Enteric Fever 'Carrier,'" Dr. Theodore Thompson uses the following definition:—

"A 'carrier' of enteric fever is a person who, although he may be in good health, carries the infectious material of the fever in his body, from which it may be given off in the stools and urine."

This very complete definition makes two important reservations. The "carrier" *may be* in good health, but the fact that he may not be so is kept in mind. Thus the definition includes not only the clinically healthy "carrier," whether acute or chronic, but also that highly dangerous person, the atypical and undiagnosed "case." Again "the infectious material . . . *may* be given off in the stools and in the urine," but the definition does not exclude those persons who, though still harbouring the germ within their bodies, yet cease, during long periods, to excrete it. The latter reservation is one that is often forgotten. In much of the literature on the subject, and worse, in many of the regulations framed to prevent or mitigate the danger to the community from this source, the question of excretion of germs receives more attention than the fundamental fact of carrying.

In fact the question of intermission in excretion, and the causes underlying it, requires thorough elucidation and constitutes one of the most important aspects of the "enteric carrier" question. To the latter point we propose to return later, but for the present will confine ourselves to the proposition *that any estimate of the number of typhoid patients who become carriers, based on the positive findings of bacteriological examination of the excreta alone, is likely to be an under-estimate.*

As is so often the case in the evolution of scientific opinion, the

[1] Parkes Memorial Prize Essay, 1912.

main facts underlying the "typhoid carrier" conception had already been recognized for some time before that conception took definite shape. From the year 1880, when Eberth first discovered the *Bacillus typhosus* and affirmed that it was the cause of enteric fever, many individual workers had added their quota to the epidemiology of the disease, and the growth of knowledge upon the subject had been uninterrupted. But the knowledge was scattered, not co-ordinated. A salient fact here and there arrested attention, and, examined perhaps without due attention to less conspicuous observations, often served to mislead instead of to guide professional opinion. Thus the correct observation that many epidemics were due to infected water supplies, led to the incorrect inference that enteric fever was almost entirely a water-borne disease. This idea in its turn served to explain the frequent association of outbreaks with infected milk. It was assumed that the milk became infected mainly through dilution with water, and thus the fact of milk-contamination, which might otherwise have led to the search for an infective human being associated with the collection or distribution of the milk, was often considered only as additional proof that water was the main enemy. Up to the time of the South African war it may be truly said that the water-borne theory of enteric fever held the field, although it was not denied that occasional direct infection took place amongst nurses and others intimately associated with cases. The following quotations from a standard textbook on medicine, published in 1901, will serve to give an idea of the average professional opinion in that year :—

"Vehicles by which the bacillus is transmitted: *Water.*— The fact that the poison of typhoid fever is in most cases carried by water has long been recognized. . . . Recently the detection of the specific bacillus in suspected water has completed the chain of evidence. . . ."

Further on it is stated that "typhoid fever is not directly contagious. Cases occurring amongst nurses and attendants can be attributed to want of care in cleansing the hands, or possibly to allowing stools passed in bed to dry on the sheets, and to be inhaled as dust."

Yet side by side with this average professional opinion there was a growing tendency of expert opinion to lay stress on the infective person rather than on the infected thing, to investigate the contagion at its source rather than in its distribution.

In 1900, Horton Smith (Goulstonian Lectures, *British Medical Journal*, vol i, 1900, p. 827) had cited the presence of the *Bacillus*

typhosus in the stools early in the disease and in the urine during the later stages, and had expressed the view that infected urine was the chief means by which typhoid fever is spread. He had also actually given expression to the conception of the "chronic fæcal carrier" as the term is now understood, for, writing on the subject of typhoid bacilli in the stools, he had said, "but we must be prepared for the possibility of their remaining in some cases a source of danger for long periods after the patient is apparently well—as long, that is to say, as the bile continues to harbour the parasite." Gwyn, too (*Johns Hopkins Hospital Bulletin*, June, 1899, p. 109) had already found and described a true urinary carrier, while Shakespeare and Reed were engaged in their great investigation of the "Origin and Spread of Typhoid Fever in the United States Military Camps, during the Spanish-American War of 1898" (published in 1904), which demonstrated beyond dispute the enormous importance of contact in the epidemiology of this disease. It remained for Robert Koch to piece together the isolated observations of many workers and to enunciate his belief that "*the chief source of typhoid infection is to be found in man himself.*" As the result of his advice, the campaign against enteric fever in South-West Germany was initiated through the agency of a series of bacteriological stations organized in the infected districts, and it was through the investigations carried out at these stations by Frosch, Klinger, Lentz and others that the conception of the typhoid carrier—both acute and chronic—came to be clearly defined and universally accepted.

To attempt a historical survey of the subject or to gather together a large number of recorded instances where typhoid carriers have been responsible for outbreaks of the disease would be merely to overburden this essay with unnecessary repetition. A very complete precis on these lines already exists in Dr. J. C. G. Ledingham's "Report to the Local Government Board on the Enteric Fever Carrier" (October 5, 1910).

It will be our aim, therefore, to keep, as far as possible, within the limits imposed by our title and to bring forward what experimental work we have at our disposal bearing upon the "causation and prevention of enteric fever in military service," with special reference to the role of "carriers."

Recalling Thompson's definition of a typhoid carrier as "a person who, although he *may* be in good health, carries the infective material in his body from which it *may* be given off in the stools and urine," it will be conceded that this definition covers not only the chronic typhoid carrier, but even the acute case, the only

essential being the *carrying* of infectious material in the body. This is as it should be, and we fully endorse the view that the acute and recognized "case" is a typhoid carrier. From the epidemiological point of view, however, the recognized case should not be very important, as the medical man in charge ought to take steps to safeguard the public from a known focus of infection. In dealing with the causation of enteric fever in military service, especially, the acute recognized case should but seldom be a source of danger to others, as the patient is almost certain to be in hospital, where the risks of transference of infection are reduced to a minimum. Still occasions may arise, especially on active service, where the acute and correctly diagnosed military case may be a serious menace to other soldiers, and we feel obliged to include such cases in the classification of "Typhoid Carriers" given below :—

Acute carriers ..	(1) Precocious carriers. Persons who harbour the germs during the period of incubation. (2) Unrecognized cases, atypical, abortive, or ambulatory. (3) Acute diagnosed cases. (4) Persons infected with the typhoid bacillus, but never showing symptoms of illness. "Paradoxical Carriers."
Sub-acute and chronic carriers	(5) Temporary. Persons who, for longer or shorter periods up to three months after an attack, continue to harbour typhoid bacilli. (6) Chronic typhoid carriers. Persons who continue for long periods to carry in their bodies the typhoid bacillus.

We would again insist that the essential point is the fact of *carrying* or harbouring in the body the infective material. Every "carrier," in this sense of the word, is a potential "excreter," though not necessarily excreting at any given moment.

The endemicity of typhoid fever in certain localities or institutions is usually to be explained by the presence in the vicinity of a chronic carrier. It is to chronic carriers too that we must look for the explanation of the carrying over of typhoid infection from one period of prevalence to another. The actual prevalence of the disease on a large scale, where not due to contamination of water-supplies, is commonly to be explained by the presence of a number of acute and temporary "carriers," persons who have been in contact with the earliest cases, or who are now themselves convalescent from acute attacks.

CAUSATION OF ENTERIC FEVER BY "CARRIERS" IN MILITARY SERVICE.

Military life differs from life under civilian conditions chiefly in the fact that the latter is individualistic while the former is communal. In the Army it is necessary, for purposes of administration and discipline, to aggregate men together in groups, these groups having in common many conditions that are not shared to the same extent in civil life. Thus food is obtained, stored, issued, and prepared on a communal basis, latrines and urinals are arranged, not for individuals, but for groups, and the same applies to living and sleeping rooms. In times of peace and under conditions of service at home, these communal conditions of life can be so carefully supervised that the dangers incident to such close association are to a great extent nullified. Still where some flaw in the arrangements exists, instances occur from time to time to demonstrate that aggregation of men together exposes them to risks which would be much smaller in life under individual conditions. Thus some of the most striking instances of outbreaks of typhoid fever due to the presence of carriers have been recorded from armies under peace conditions and from certain civilian communities where conditions of life similar to those incident to military service exist, such as asylums, schools, reformatories and institutions. We quote, without attempting to describe, the following military instances from the British and other armies :—

(1) An outbreak at Aldershot, described by Major Cochrane, R.A.M.C. (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, February, 1909), where a series of cases was definitely traced to a urinary "carrier."

(2) An epidemic at Kilworth Camp in Ireland, described by Captain J. Dorgan, R.A.M.C. (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, April, 1910), in which the origin of twenty-four cases, occurring from May to August, 1909, was traced to a female urinary carrier employed as dairymaid at the farm whence milk for the troops was obtained. There had been, in addition, fourteen cases amongst civilians associated with this carrier.

(3) Local endemicity of typhoid fever in the Artillery Barracks at Wesel, reported by Niepratschk (*Zeitschr. für Hyg.*, Bd. 64, p. 454), found to be due to the presence of a urinary carrier, Sergeant B.

Instances could be multiplied to the same effect, but the foregoing suffice to demonstrate that the typhoid carrier *is* a cause of enteric fever in military life, and to illustrate our contention

that aggregation of men together in barracks exposes them to increased danger. It will be noted also that in all these instances, a chronic carrier was responsible for the outbreak.

In all three instances, therefore, the circumstances were very exceptional, in that some flaw in the sanitary organization co-existed with the presence in the community of that comparatively rare phenomenon, the chronic carrier. In an editorial on the subject of carriers in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for April, 1910, the opinion is expressed "that if care be taken to exclude them from employment in the preparation of food and drink, infection is not likely to be caused by the presence of a few carriers amongst the community, especially if a water carriage system of sewage disposal be in vogue." With this opinion we are in complete accord, where the implied conditions exist. In peace the danger of carriers is small and would be practically nil if, as the Editorial quoted assumes, their presence were known, and they could be excluded from the preparation of food and drink. Unfortunately their presence is, as a rule, only revealed during the investigation of a series of cases resulting from them, and the same investigation usually calls attention also to some defect in the sanitary routine, without which the carrier would have been powerless to infect others. Even in peace time then, the soldier is exposed by the conditions of his service to some danger from carriers, a danger which can be reduced almost to vanishing point by perfection in sanitary organization. But the Army only exists in peace for its true function, war. In peace time the aggregation of troops into large communities is as far as possible avoided, as a wide distribution of units facilitates maintenance, and places comparatively small bodies of troops at the disposal of the civil power in a large number of localities. In war, where the success of the operations often depends upon numerical superiority at some definite point, aggregation of troops on a large scale is a necessary condition. Further, the fixed sanitary routine, by which excreta are got rid of in peace, gives place in war to a series of improvisations, trench latrines taking the place of "water-carriage" or other systems of a permanent kind. At the same time the troops are exposed to severe exertions, and are liable to be placed on a less satisfactory scale of rations, while the possibility of detecting and isolating carriers, where the presence of these persons is suspected, becomes remote.

Theoretically, then, it is to be expected that the typhoid carrier will be a factor of great importance in the causation of enteric fever

in armies in the field. Putting aside theory, and turning to the history of war, we find that enteric fever has, in the past, arisen amongst armies operating in localities where this disease was not known to exist before the troops arrived.

The Principal Medical Officer (Surgeon-General W. Taylor, C.B., A.M.S.) writes as follows concerning enteric fever amongst troops in India (Army Medical Department Report, 1898) :—

"The liability of troops on service to enteric fever, *even when encamped on virgin soil*, is a fact in regard to which all observers are unanimous." This officer is driven to the conclusion that "it may be that the enteric bacillus is more widely distributed in nature than our present knowledge leads us to suppose." Later, as Principal Medical Officer (British troops) of the Nile Expedition, 1898, Surgeon-General Taylor is again face to face with the same problem. He reports of enteric fever that, "This disease was, as usual, the scourge of the Army in the Sudan. . . . It is responsible for nearly half the mortality of the campaign, and caused more than double the deaths of both battles put together. The specific germs are no doubt swarming in both earth and water . . ." (Army Medical Department Report, 1898). In both cases we find that recourse is had to "a wide distribution of the specific organism in nature" to explain the occurrence of this disease in bodies of troops operating in sparsely populated countries, where the possibility of infection *from outside* is otherwise difficult to account for. In the same year (1898) occurred the Spanish-American War, with epidemic prevalence of enteric fever amongst the American troops. In this instance the outbreak assumed such terrible proportions that three specially qualified officers (W. Reed, Victor C. Vaughan, and E. O. Shakespeare) were detailed to investigate it. Their conclusions, published in 1904, mark an epoch in the history of military hygiene. They abandon the attempt to explain the outbreak by "infection from without," and boldly assert the view that the troops had brought the specific organism with them in the bodies of certain of the soldiers. "Infected water," they say, "was not an important factor in the spread of typhoid fever in the National encampments in 1898. With typhoid fever as widely disseminated as it is in this country, the chances are that if a regiment of 1,300 men should be assembled in any section and kept in a camp, the sanitary condition of which was perfect, one or more cases of typhoid fever would develop." . . . "When a Command, badly infected with typhoid fever, changes its location it carries the specific agent of

the disease *in the bodies of the men,* in their clothing, bedding, and tentage."

Here are ideas that, applied to the campaigns on the Indian frontier and in the Sudan, would serve to explain the occurrence of enteric fever without the uncomfortable and improbable theory that the germ of the disease is "widely distributed in nature." The importance of "contact" with infected persons, the possibility of carriage of the specific agent in the human body, and the role of flies as transmitters of infection are all clearly brought out in the invaluable report of Reed, Vaughan, and Shakespeare.

"The Medical History of the War in South Africa: An Epidemiological Essay," by Lieutenant-Colonel R. J. S. Simpson, C.M.G., R.A.M.C., is perhaps the most weighty contribution yet made to this subject. This officer, whose valuable paper on the prevalence of enteric fever in Pietermaritzburg (Army Medical Department Report, 1898) shows such a thorough comprehension of the conditions bearing on typhoid fever in South Africa, forms the opinion that the mode of development of the epidemics in the different military groups during the war suggests an auto-infection, and appears not to be explained by any theory of external infection of the mass. Having discussed the possibility of the epidemics having been caused by infected soil or infected water, he concludes that, "None of these external causes suffices to explain the mode of development of these outbreaks. There remains the theory of personal contact, using this term to include direct personal infection from close association, the infection of a commensal, and indirect infection through excreta." It is to this "contact" that the author attributes the prevalence of enteric fever during the South African War, and his careful and unprejudiced analysis of the statistics on which his paper is founded is very convincing.

The deductions of Shakespeare, Vaughan, and Reed, and the close statistical study of enteric fever on active service by Simpson, demonstrate the importance of "contact" in the spread of the disease in military aggregations, but the origin of the early cases from which "contact" was operative might still have been sought in some external location of the specific agent. It remained for Lieutenant-Colonel Sir D. Semple, Captain E. D. W. Greig and their co-workers in India to apply the discoveries of Frosch and Klinger in South-West Germany to a military population and to place beyond doubt the important role of "carriers" in initiating outbreaks of enteric fever. They showed "that the conditions met with outside the human host are not favourable to the prolonged

existence of the *B. typhosus*, and therefore, the persistence of the disease cannot be explained by a hypothesis that postulates long extra-corporeal existence of the bacilli. . . . It is brought home to us more clearly that conditions outside the human body cannot favour the growth of the parasite; at the best they can act only as channels of communication, and these channels soon dry up unless fed from the reservoir, the human host."

The human host then, or in other words, the "carrier"—whether acute or chronic—is the essential factor in the origin and maintenance of enteric fever in armies, whether in peace or in war.

Factors in the Causation of Enteric Fever by "Typhoid Carriers."

In the foregoing paragraphs we have summarized the evidence upon which we base our opinion that carriers are the most important factor in the causation of enteric fever. We shall now attempt to deal with the mechanisms by which these persons infect others, as far as possible systematizing our argument under the four following headings:—

(1) Conditions associated with the carrier.
(2) Survival of the *B. typhosus* outside the human body.
(3) Means of transmission from the carrier to the recipient.
(4) Conditions associated with the recipient himself.

(1) The Carrier.

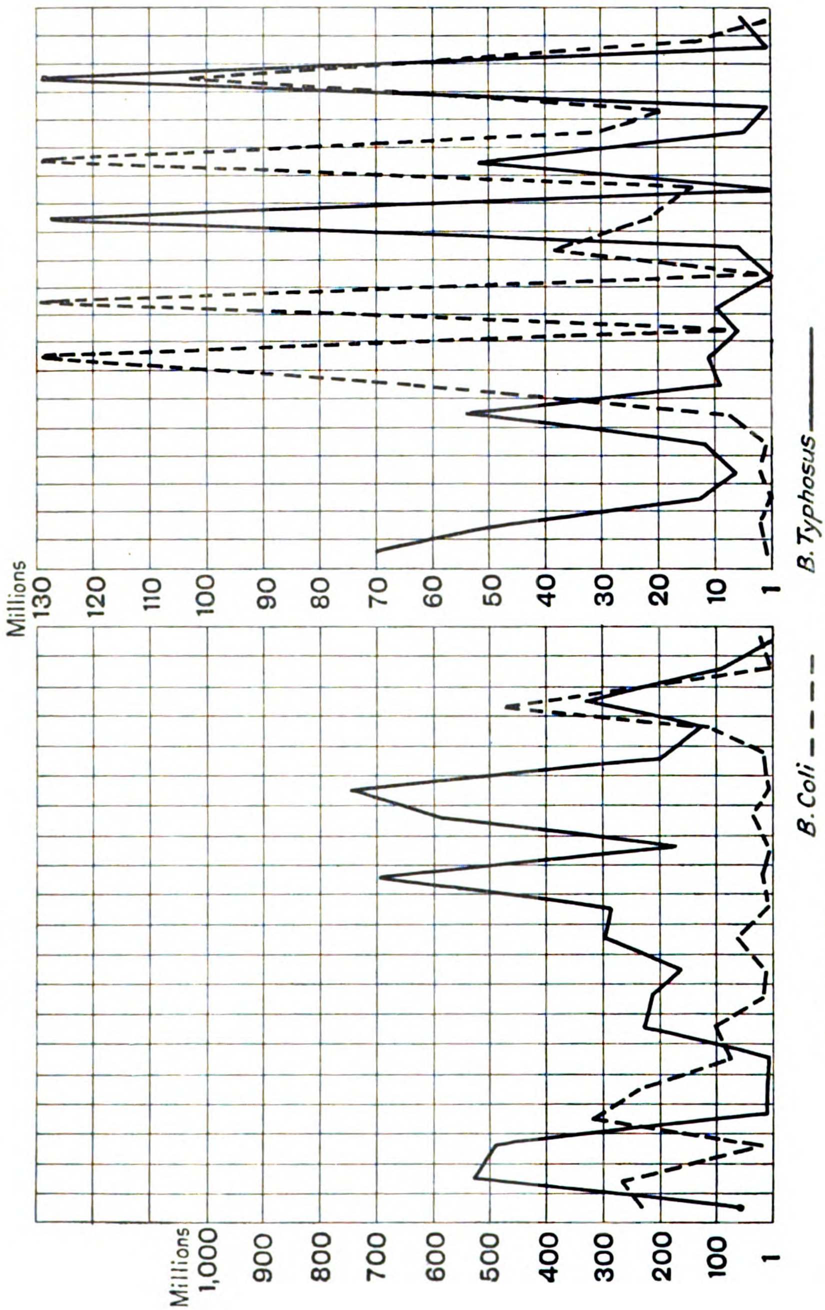
(*a*) *The Relative Danger of One Variety of Carrier as compared with Another.*—This has been investigated by Klinger ("Epidemiological Observations on the Anti-typhoid Campaign of the German Empire," Dr. Klinger, vide précis in Journal of The Royal Army Medical Corps, vol. xiv, p. 90), who found that, of 1,397 cases traced to this source, 1,272 were caused by acute carriers—that is to say actual cases—and 125 by chronic carriers. Of 812 cases traced to acute carriers, 183 were infected from persons in the incubation stage, precocious carriers, a further 554 by acute cases in the first five weeks of the attack, and 75 by convalescents up to the end of the tenth week. It may be presumed that the majority of the acute cases would have been sooner or later diagnosed and isolated under military conditions in peace, but it is probable that in war, many of the men would have attempted to "stick it out," and would thus have escaped diagnosis until they reported sick in a condition that precluded further work, probably

early in the second week of illness. It is fair to assume that from 250 to 300 of the above cases were caused by persons who would have been at large and infective under military conditions in peace, equally as in civilian life. But the opportunities for spreading the disease must have been much more restricted in the case of these civilian "acute carriers" than would have been the case on active service, so that the figures certainly under-estimate the "typhoid productivity" of acute carriers in war. All that we can infer from them is that once enteric fever has actually broken out amongst troops in the field, the presence of precocious carriers, atypical and abortive "cases" and infective contacts will serve to maintain, and to increase in geometrical ratio, the amount of infective material menacing the healthy. The extent to which atypical and mild cases may be present during an outbreak of the disease is well shown by an analysis of an epidemic occurring in the French Army in 1909 (*Archives de Méd. et de Pharm. militaires*, April, 1909), where out of a total of 142 cases, 57 were only discovered by persistent medical inspection, these men not having reported sick. Of the cases so discovered, 39 were so little affected by their illness that it was enough merely to isolate them in barracks, treatment in hospital being unnecessary. The chronic carriers that take the field with every army may be expected to manifest their presence by giving rise to an appreciable number of cases in from forty to sixty days after operations commence. Vaughan, Reed, and Shakespeare found that every unit mobilized during the Spanish-American War had developed cases of typhoid fever *by the eighth week*. Simpson, in his "Medical History of the South African War" says, "We have seen that in four large bodies of men, *an incubation period of the epidemic of enteric fever occurred of about eight weeks' duration*, i.e., more than twice the accepted maximum incubation period of the individual, and this was independent of the environment of the troops concerned." We shall discuss this question—the "eight weeks phenomenon"—later, but would here point out that on active service, we must anticipate that the problem of "acute carriers" will require attention from about the sixth week and onwards. The magnitude of the problem will depend upon how thoroughly we have sought for and dealt with the chronic carriers before taking the field, and upon how completely our field sanitary measures have been carried out during the early weeks of the campaign.

(*b*) *The Number of Germs Excreted by Chronic Carriers.*—Intimately associated with the last point dealt with is the *number*

Chart I.—Bacterial Content (one gramme) in *B. Typhosus* and *B. Coli* of two Fæcal Carriers.

Carrier S. *Carrier F.C.*



The charts show a tendency to an inverse relation between *B. coli* and *B. typhosus*.

of typhoid bacilli excreted by carriers. The average number for a series of observations on two chronic "fæcal" carriers, for a period of three months, is given in Chart I, which shows graphically the fluctuations in the excretion of *B. typhosus* and *B. coli* in the two fæcal carriers during twenty successive "counts" of the bacterial contents per 1 grm. of fæces. It will be seen at once that individuals differ widely in the numbers excreted, the average for Carrier W. S. being about seven times as great as that for Carrier F. C.

Further, the individual variations for each carrier are very great. The highest count that we have ourselves recorded amounted to over six thousand millions of typhoid bacilli in 1 c.c. of urine in Carrier F. I., and from this enormous figure to one thousand two hundred bacilli per 1 c.c. represents the variation for this urinary carrier during a period of observation covering just over four years. During a series of constant observations for three months, the man being under hospital conditions and not subject to fatigue or exertion, the average number per 1 c.c. was slightly above two and a half millions, while in another urinary carrier observed at the same time the average excretion was under seven thousand bacilli per 1 c.c. *Taking the two fæcal and two urinary carriers together for three months of consecutive observation, the average excretion per man amounted to nearly eighty million bacilli per gramme or cubic centimetre.* Let us try to imagine in terms of contamination power what this means. Suppose that 100 c.c. of infected urine gains access to a collection of water amounting to one million gallons, the water-supply of an army of 500,000 men for one day, and becomes evenly distributed through it, there will be one thousand typhoid bacilli in every pint of the contaminated water. It is not suggested that such a vast body of water could possibly be evenly contaminated by any small addition of fluid, nor that the germs added with this urine would survive for long, but the example may serve to emphasize the potentiality of a single carrier. The great variations in the numbers passed by any one individual at different times give grounds for interesting speculations as to the carrier state. On what do these variations depend? Variations can be brought about under known conditions. It is beyond question that the number of germs excreted is greater after exertion or anything causing fatigue. Carrier F. I., when in hospital, excreted on a much lower level than when out of hospital and at work. Again, the injection of a moderately large dose of antityphoid vaccine will constantly increase the number of bacilli in the urine, a fact first

noted by Irwin and Houston (*Lancet*, January 30, 1909) and which we observed after every large dose in the case of Carrier F. I. (Table I). Again there appears to be a tendency to an inverse ratio between the excretion of *B. typhosus* and *B. coli* in the case of fæcal carriers (*vide* Chart I), and as will be shown later (page 654) the latter organism is able, within a comparatively short space of time, to

TABLE I.—OBSERVATIONS ON "CARRIER F.I." (URINARY) DURING A COURSE OF VACCINE THERAPY IN HOSPITAL.

Date	Vaccine inoculation. Number of dead typhoid bacilli injected	Number of *B. typhosus* excreted per 1 c.c. of urine	Opsonic end point (Klien), and agglutination		Pain over left kidney following injection	Frequent micturition following injection
			Ops.	Agg.		
7.11.11	Admitted to hospital					
8.11.11	..	8,000,000	..	..	..	..
10.11.11	..	1,524,000	..	..	..	..
12.11.11	100 million	..	..	..	..	..
13.11.11	..	100,000	..	..	–	–
17.11.11	..	100,000	..	$\frac{1}{100}$	..	..
20.11.11	250 million	270,000	..	..	..	..
21.11.11	..	470,000	..	$\frac{1}{100}$	+ +	+ +
23.11.11	250 million	..	..	..	..	..
24.11.11	..	4,600,000	..	..	+ + +	+ + +
27.11.11	..	430,000	..	$\frac{1}{100}$	+	+
29.11.11	10 million	..	..	..	..	..
30.11.11	..	1,100,000	..	$\frac{1}{50}$	..	..
3.12.11	125 million	..	..	..	..	..
4.12.11	..	115,000	$\frac{1}{150}$	$\frac{1}{100}$	–	–
9.12.11	..	270,000	..	..	–	–
10.12.11	500 million	..	..	..	..	..
11.12.11	..	360,000	..	$\frac{1}{100}$	±	–
15.12.11	..	650,000	$\frac{1}{150}$	..	–	–
17.12.11	1,000 million	..	..	..	..	..
18.12.11	..	800,000	$\frac{1}{150}$	..	+	+
21.12.11	..	180,000	..	..	–	–
26.12.11	1,250 million	..	..	..	..	..
27.12.11	..	5,025,000	$\frac{1}{150}$	..	+ + +	+ + +
1.1.12	..	1,790,000	$\frac{1}{150}$	..	–	+
4.1.12	250 million	..	..	..	..	..
5.1.12	..	615,000	..	..	–	–
7.1.12	Absented himself without leave, 24 hours					
8.1.12	..	11,500,000 High count probably from exertion and beer.				

Excretion by Carrier F.I. while out of hospital and engaged in manual labour

Date	No. per c.c. urine
30.1.12	30,800,000
15.2.12	200,000,000
17.3.12	20,730,000
24.9.12	6,200,000,000
9.10.12	6,116,000
28.10.12	2,020,000,000

It is to be noticed that, as the immunization proceeded larger doses were tolerated without reaction; but the too close approximation of one dose to another, or any excess of dose over the margin of toleration, at once evoked increased "excretion" and focal reaction.

completely outgrow and eliminate the former. The more rapid the transit of fæces through the bowel, the shorter will be the period of competition with *B. coli* and other organisms, and the more numerous the surviving *B. typhosus*. Where diarrhœa is a prevalent disease, therefore, the excretion of *B. typhosus* by carriers will be, as a rule, increased. It may be expected then that on active service, where over-exertion is the rule and where exposure to chill, bad cooking, and other causes almost invariably leads to diarrhœa,

the output of infective material by carriers will invariably be much greater than the figures quoted as observed under conditions of rest in hospital.

TABLE II.—COMPARISON OF A "CARRIER" STRAIN (F.C.) WITH (1) A LABORATORY AND (2) A VIRULENT TYPHOID CULTURE, AS TO SERUM-SOLUBILITY.

Experiment 1.

Emulsion dilutions	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{128}$
	Numbers of colonies surviving in each dilution.						
Strain "F.C." + Immune serum	Film	Film	Film	Film	Film	Numerous discrete colonies	Numerous discrete colonies
Laboratory strain + Immune serum	Film	Numerous discrete colonies	Numerous discrete colonies	19	7	1	1

Experiment 2.

Emulsion dilutions	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{128}$
Virulent strain from acute case + Immune serum	Film	Film	Film	Film	Film	Film	Film
Strain "F.C." + Immune serum	Film	Film	Film	Film of discrete colonies	Film of discrete colonies	Numerous discrete colonies	Numerous discrete colonies
Laboratory strain + Immune serum	Discrete colonies	Discrete colonies	Discrete colonies	Numerous discrete colonies	A few discrete colonies	0	0

Equal volumes of immune rabbit serum and each of a series of dilutions of the bacterial emulsions were mixed together and kept at 37° C. for two hours. The mixtures were then blown on to agar slopes, and the latter incubated, the colonies being counted next day.

It will be seen that the "Carrier" strain was much less soluble than the old Laboratory strain, but more so than the fresh virulent strain from an acute case.

(*c*) *The Virulence of the Germs excreted by Carriers.*—This question has received considerable attention and the evidence to hand justifies no definite conclusion as to whether carrier strains are more or less virulent than strains isolated from acute cases of enteric fever. Lentz (" Ueber Chronische Typhusbazillenträger," *Klin. Jahrbuch*, Bd. xiv, p. 475) was unable to show any constant difference in virulence between twenty carrier strains and various

other strains of *B. typhosus* at his disposal. Ledingham (Report to the Local Government Board, 1910) failed to find conclusive evidence on this point. We have found that a freshly isolated strain from Carrier F. C. was much less easily killed by normal serum than was an old laboratory culture, but, on the other hand, a strain freshly isolated from the blood of an acute case was more resistant than the carrier strain (Table II).

We regard the question of virulence as more or less academical, since there is ample evidence to prove that carrier strains are able to bring about acute and often fatal infection of healthy persons—a point of much greater significance than any record as to the number of germs necessary to kill a 250-grm. guinea pig on intraperitoneal inoculation.

(2) Survival of the B. typhosus Outside the Human Body.

Much work has been done on this subject, and much remains to be done. When an external origin was invoked for every epidemic, it was natural that soil, water and other external objects should be thoroughly examined as to their powers of supporting the life of *B. typhosus*. A great deal of earlier work must be regarded with grave suspicion as the various organisms constituting the typhoid-colon group have only recently been satisfactorily separated, and there seems no doubt that many strains recovered from soil, water and sewage, and confidently regarded as *B. typhosus* by the observers concerned, were in reality other organisms.

As the means of recognition of *B. typhosus* have been perfected, so the period of survival outside the body attributed to it has drawn in and diminished. There is still, however, a decided discrepancy between the work of thoroughly reliable observers. Horrocks and Firth, for instance ("An Inquiry into the Influence of Soil, Fabrics and Flies in the Dissemination of Enteric Infection," *British Medical Journal*, September, 1902), found that soil contaminated with excrement from enteric cases remained infective for a long time, the specific germ being recognized for periods varying from 45 to 74 days, while fabrics such as khaki drill, serge, &c., soiled with typhoid cultures permitted the recovery of the *B. typhosus* for many weeks, and with typhoid fæces, to seventeen days. On the other hand, Semple, Greig and their co-workers found that this organism rapidly disappeared from urine and fæces outside the body, and that fabrics contaminated with infective stools and exposed to the sun rapidly became sterile. The explanation may be sought in the fact that one series of experiments was

carried out in the South of England, the other in India, where the sun is much more powerful. It may be noted that the latter workers found that "control" fabrics kept in a cupboard where the sun was unable to act on them remained infective up to six days, though not to seventeen.

We may summarize our experiments under the following headings :—

A. Survival of the *B. typhosus* in excreta.
B. ,, ,, ,, on clothes of carriers.
C. ,, ,, ,, on fingers of carriers.
D. ,, ,, ,, in food.

A. In Excreta.

(1) *Survival of the* B. typhosus *in Urine.*

On several occasions we have recovered *B. typhosus* from the urine of Carrier F. I. up to six and seven weeks after passing. We have made only two attempts to keep it for longer periods. In one the organism was still present in large numbers, and apparently in pure cultures, up to three months. The flask was then emptied by an attendant in error, and further examination was thus stopped; but there seems no reason why this specimen should not have continued to retain the organism for very long periods. On a second occasion a specimen containing enormous numbers of *B. typhosus* was put aside. When examined after two months, no *B. typhosus* was isolated,[1] but a small number of *B. fæcalis alkaligenes* had taken its place. These experiments had only an academical value, as urine is unlikely to remain under sterile conditions in nature. It is to be observed that where the *B. typhosus* disappeared, its place was taken by another organism. In nature competition with other organisms is likely to be severe, especially as urine is commonly voided so that it ultimately mixes with fæcal sewage. For this reason it appeared important to ascertain the effect of the addition of fæces to a sample of urine from a typhoid carrier. The results are shown below :—

(2) *Effect of Fæcal Contamination on the Survival of* B. typhosus *in Urine.*

Experiment I.—A sample of urine from Carrier F. I. was divided into two equal parts. To one part was added an emulsion

[1] Survival up to one year of *B. typhosus* in urine kept under laboratory conditions has been recorded by Horrocks (Journal of the Royal Army Medical Corps, vol. xvi, p. 225).

of normal fæces. The other part was kept unaltered. Both flasks were allowed to remain at room-temperature. Plates were made from each flask daily from October 23 until November 1, 1909.

Result.—(1) *B. typhosus* was isolated on every day of observation from the uncontaminated urine.

(2) *B. typhosus* mixed with *B. coli* was isolated in diminishing numbers from the contaminated urine sample up to October 25. No *B. typhosus* was found on the plate on October 26. Four colonies of *B. typhosus* were isolated, amongst many *B. coli* colonies, on October 27. From that date onwards no *B. typhosus* could be isolated from the contaminated urine.

Experiment II.—A specimen of urine from Carrier A. was divided into two equal portions. One portion was contaminated by the addition of emulsion of normal fæces. The other portion was left uncontaminated. Both samples were kept at room-temperature from November 3 to November 16, 1909, plates being prepared from each on every day of the experiment except November 8 and November 15.

Result.—*B. typhosus* was recovered on every day from the uncontaminated sample, the "count" amounting to 91,500 bacilli per cubic centimetre on November 16.

B. typhosus was recovered in decreasing number, mixed with *B. coli*, from the contaminated sample up to November 14. No *B. typhosus* could be recovered from the contaminated flask on November 16, by which date *B. coli* and some streptococci were the only organisms demonstrable in the sample.

In the first experiment *B. typhosus* disappeared after the fifth day. In the second it was still recovered in small numbers up to the twelfth day, after which it disappeared. *The difference is to be explained by the initial number of* B. typhosus *in the samples used.* The "count" of the urine on passing in Experiment I was only 12,600 bacilli per 1 c.c.; while in the second experiment it was 2,691,000 per 1 c.c. In both cases the urine that was left uncontaminated continued to contain the *B. typhosus* up to the end of the experiment.

(3) *Survival of* B. typhosus *in the fæces of a Carrier at Room-Temperature.*

Experiment I (Fæces).—One sterile watch glass of fæces freshly passed by Carrier C. was taken and emulsified in 100 c.c. of sterile water. The mixture was placed in a sterile flask. The presence

of *B. typhosus* in the emulsion was verified by plating on the first day of the experiment, March 5, 1912.

March 7, 1912: "Plated" and recovered *B. typhosus* in large numbers, mixed with a few *B. coli*.

March 8, 1912: Recognized numerous *B. typhosus* on plates. Few *B. coli*.

March 15, 1912: Recovered numerous *B. typhosus* on plates. Few *B. coli*.

March 26, 1912: Recovered thirty-three colonies of *B. typhosus* with twelve colonies of *B. coli* mixed with innumerable small colonies of a streptococcus. The *B. typhosus* has greatly diminished in number. *After this date* B. typhosus *was not recovered.*

(4) *Effect of other Organisms on the Survival of* B. typhosus *in Fæces.*

Experiment I (*Fæces*).—An emulsion of normal fæces was divided into two portions of 50 c.c. each. One portion was "autoclaved" at 115° C. for twenty minutes to render it sterile. The other portion was not sterilized. To each flask was then added an emulsion of one agar slope of *B. typhosus* in sterile saline. The flasks were kept at 37° C. from September 29, 1910, until completion of the experiment.

On October 1.—Plates prepared from the "sterilized" fæces showed enormous numbers of *B. typhosus*. Plates from the unsterilized fæces showed about equal numbers of *B. typhosus* and *B. coli*.

By October 3 only *B. coli* could be isolated from the unsterilized fæces, *B. typhosus* having disappeared.

B. typhosus was isolated in pure culture from the sterile fæces on February 15, 1911, after which the experiment was discontinued.

In Experiment I (fæces) the *B. typhosus* started in large excess of *B. coli*. Perhaps on this account the *B. typhosus* was able to survive, though in steadily diminishing numbers, for twenty-two days. Here both *B. typhosus* and *B. coli* were subjected to destructive competition with organisms not belonging to the typhoid-colon group, such as streptococci and others. Probably the latter grew better at room-temperature than did the "human" parasites, *B. typhosus* and *B. coli*. In the second experiment, an attempt was made to put the influence of competitive existence with other organisms on a more certain basis. The influence of the fæces itself, as opposed to its living content, was assumed to be operative

in the portion of the fæces which had been sterilized. In this the *B. typhosus* was still living, and abundant *four and a half months after the inception of the experiment.* In the flask where the "live" fæces was used, it was not possible to isolate *B. typhosus* on *the third day*, this organism being completely outgrown by *B. coli* at body temperature.

This action of *B. coli* was regarded as so important that it was thought worth further investigation,[1] on a quantitative basis, the results of the foregoing experiments having decidedly pointed to the significance of the relative numbers of *B. typhosus* and *B. coli* respectively in the original mixtures. The following experiment was therefore carried out:—

Experiment II.—Emulsions of *B. typhosus* (a strain from the blood of an acute case, eighteen months under laboratory conditions at room-temperature) and of *B. coli* (isolated a month before from the urine of a case of chronic pyelitis) were prepared in normal saline solution, and standardized so that each contained 1,000 million organisms per 1 c.c.

A thick emulsion of normal fæces was prepared, strained to get rid of lumps, and divided into quantities of 25 c.c. in each of five flasks. The flasks were then placed in the autoclave for twenty minutes at 115° C., removed, and allowed to cool. To each flask was then added a mixture of the two bacterial emulsions as follows:—

Flask 1 ..	0·9	c.c.	typhoid	emulsion
	0·1	,,	coli	,,
,, 2 ..	0·7	,,	typhoid	,,
	0·3	,,	coli	,,
,, 3 ..	0·5	,,	typhoid	,,
	0·5	,,	coli	,,
,, 4 ..	0·3	,,	typhoid	,,
	0·7	,,	coli	,,
,, 5 ..	0·1	,,	typhoid	,,
	0·9	,,	coli	,,

It will be noted that *B. typhosus* was in excess in flasks 1 and 2, *B. coli* in excess in flasks 4 and 5, while in flask 3 the organisms were in equal numbers, the whole being placed in a sterile emulsion of human fæces so that the *mise en scène* was correct. The flasks were placed (November 12, 1911) in the incubator at 37° C.

Next day (twenty hours) plates were prepared.

[1] For a series of experiments on this point, see Horrocks, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xvi, p. 225.

Result:—

From Flask 1	..	*B. typhosus*,	20 colonies
		B. coli,	350 ,,
,, ,, 2	..	*B. typhosus*,	23 ,,
		B. coli,	154 ,,
,, ,, 3	..	*B. typhosus*,	8 ,,
		B. coli,	156 ,,
,, ,, 4	..	*B. typhosus*,	15 ,,
		B. coli,	223 ,,
,, ,, 5	..	*B. typhosus*,	*nil*
		B. coli,	140 colonies

It will be seen that *B. coli* had already established an excess in all the flasks, and that in flask 5 *B. typhosus* had disappeared. The excess of *B. coli* was not, however, in proportion to the relative numbers of each organism in the original preparations, a point which we cannot at present explain. On the fifth day of the experiment (November 17, 1912) plates were again made with the following results:—

B. typhosus was recovered in very small quantities from flasks 1, 2, 3, and 4 only. *B. coli* was in enormous numbers on all the plates.

On the eighth day (November 20, 1912) the flasks were again examined by plating, two colonies of *B. typhosus* being isolated from flask 2, and one colony from flask 3, while *B. coli* was in uncountable numbers on all the plates.

The flasks were then left at room temperature for a week, and again examined. On this final examination, no *B. typhosus* was isolated from any of the flasks, the *B. coli* having completely established its ascendency.

We consider that these experiments, while undoubtedly throwing some light on the fate of *B. typhosus* when in competition with other organisms, must not be taken to prove that this organism is unable to survive in sewage. In all attempts to recover *B. typhosus* on plates, the relative numbers of other organisms present must be taken into account. We find it impossible to make accurate "counts" when there are more than approximately a thousand colonies on a 4-in. plate, or say, five thousand colonies on a "Drigalski" plate. Numbers in excess of these invariably lead to fusion of neighbouring colonies. Now fusion of colonies of *B. coli* leads to a deep red coloration on neutral red lactose plates, or a deep green on "Conradi" or "Fawcus" plates, and on every medium that we have tried, the chances of finding a typhoid colony, where it is outnumbered by coli to the extent of say, 10,000 to 1,

are very small. If the fæces be diluted so as to give "countable" plates of *B. coli*, the typhoid bacilli may be "diluted out" to vanishing point. In higher concentrations, the fusion of *B. coli* colonies leads to mechanical difficulty in finding such typhoid colonies as may be present.

It may be assumed, then, that failure to find *B. typhosus* on plates is not final proof that it is absent from the fæces. There is, on the other hand, some reason to believe that this organism *can* survive for considerable periods in sewage. Firth reports the case of a boy who appears to have been infected directly from a "Stoddart Filter" septic tank, the sewage treated in which was liable to contain *B. typhosus*, as a case was then being nursed in a building within the collection area of the sewage. (Note on an unusual cause of enteric fever infection, Lieutenant-Colonel H. Firth, R.A.M.C., JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. iv, p. 55). Again, Gielt (quoted by Shakespeare, Vaughan, and Reed) calls attention to a series of cases that point strongly to survival of *B. typhosus* for considerable periods in sewage. "A man, away from home, contracted typhoid fever, returning to his village where no cases had occurred for a long time. His fæces, not disinfected, were thrown on a dung-heap. Five men carted away the latter some weeks afterwards. Of these men four developed typhoid fever, and one had intestinal catarrh with enlarged spleen. The undisinfected fæces from some of these cases were thrown on another dung-heap. *A few months later* two men removed this collection, and one of these contracted typhoid fever.

The report, as quoted, does not state whether the fæces of the convalescents were still being thrown on the dung-heap when the latter was removed, but the implication is that the *B. typhosus* survived for a long time in the dung-heap.

In conclusion, we would lay great stress on the relative numbers of *B. typhosus* in the excrement when passed, and on the temperature prevailing outside the body during subsequent periods. *B. coli* is likely to have a decided advantage at temperatures approximating to body-heat. This may explain why Semple and Greig failed to recover *B. typhosus* from a carrier's fæces after the fifth day, in India, while we have recovered it up to the twenty-second day in England, and it may serve to reconcile the apparent divergence between the work of Semple and Greig on the one hand, and of Firth and Horrocks on the other.

B. Survival on Clothes of "Carriers."

We consider that sufficient work has been done by others as to the time of survival of *B. typhosus* on fabrics under various conditions. It seemed, however, to be worth while to attempt to ascertain whether this organism could be isolated from the clothing of carriers.

Experiment I.—The soiled shirts from three "fæcal" and two "urinary" carriers were intercepted on their way to the disinfecting apparatus, and treated as follows: Selected portions of the shirts were wetted with sterile water, and wrung out over bile salt lactose plates, which were then incubated. Result: No *B. typhosus* isolated from any of the plates.

Experiment II.—Pieces of linen were sewn into "selected" positions on the inside of the shirts of the above carriers. After three days' wear these portions were detached and kept for three days at room temperature. They were then cut up into small pieces, and added to bile salt brilliant green peptone water, which was incubated and "plated." Result: Motile Gram-negative rods, not fermenting lactose, were isolated from the clothing from Carriers S. (urinary) and L. (fæcal). These colonies proved *not* to be *B. typhosus*, but were obviously of excremental origin. Their presence may be taken to show that fæcal bacteria will survive on the garments of carriers, a point to be noted in connection with laundry work. We regret that the pieces of linen had to be kept three days at room temperature, as this delay may have conditioned the negative result of the experiment. We had no opportunity of repeating it.

C. Survival on the Fingers of Carriers.

The following technique was employed in all the experiments:—

The fingers were washed in a small quantity of sterile water in a sterile "Petri" dish, or watch glass; the resulting dirty water was added, as a rule, to bile salt peptone water or else centrifugalized, and the deposit plated. The fingers, too, were passed over the surface of bile salt plates while still moist after washing. The media were then incubated and examined for *B. typhosus*.

Experiment I.—(July 26, 1909). Fingers of fæcal carrier S. examined. Result: Negative.

Experiment II.—(November 2, 1909). Fingers of urinary carriers F. I. and S. examined (one hour after passing urine). Result: Carrier F. I., *many colonies of B. typhosus* both on "direct" plates and from the bile-salt peptone water. Carrier S Negative.

Experiment III.—(November 6, 1909). Two urinary and three fæcal carriers were paraded without previous warning, and with no reference to the time since excreta had been voided. The fingers of all were examined as above. All were negative as regards *B. typhosus.* From fæcal carrier L., however, a fair number of motile Gram-negative bacilli were isolated, giving the cultural reactions of *B. fæcalis alkaligenes.* They were, however, agglutinated completely by a 1 in 100 dilution of anti-typhoid serum, and partially in dilutions up to 1 in 400. It may be added that the strain of *B. typhosus* from Carrier L. was very resistant to agglutination, only reacting completely up to 1 in 200 of the same anti-typhoid serum. Unfortunately, the culture kept for further examination was thrown away inadvertently when changing stations, and we were unable to go more completely into the nature of the interesting organism isolated from the fingers of Carrier L.

The series of experiments quoted serves to prove that *B. typhosus* itself, as well as other fæcal organisms, can be isolated from the fingers of "carriers," a fact of great importance in connexion with the contamination of food supplies. The following experiments show the effects of washing and removing the bacilli from infected fingers:—

Experiment IV.—To ascertain whether a finger infected with urine is easily sterilized. (September 26, 1912.) Dipped the tip of the right index finger in the urine of typhoid carrier A (proved to contain upwards of 3,000 million per cubic centimetre). (*a*) Rinsed in lysol solution (approximately 2 per cent). (*b*) Then held the finger under the tap, rinsing first in cold, then in very hot water (temperature not recorded). (*c*) Washed very carefully in about 0·5 c.c. of sterile water in a watch glass, and plated the whole of the water used for this purpose. Result: Three hundred and thirteen colonies of *B. typhosus* on the plate. (*d*) After the washing in sterile water mentioned under (*c*), the tip of the finger was thoroughly soaked in absolute alcohol, allowed to dry, and the washing in sterile water repeated. The "washings" were again "plated." Result: Four colonies of *B. typhosus.*

Experiment V.—(October 3, 1912.) Contaminated the tip of left second finger with urine from Carrier A. (*a*) Allowed the finger to dry; (*b*) washed very thoroughly with soap and water under a running tap. *Dried thoroughly with a cloth.* "Washed" thoroughly with 0·5 c.c. of sterile water in a watch glass and plated the "washings." Result: No *B. typhosus* isolated. (*c*) Finally dipped the finger in lysol solution (2 per cent), scrubbed, dried with

a cloth, "washed" as before and plated the "washings." Result: No *B. typhosus*.

The first experiment shows that it may be very difficult to free a finger from contamination by *B. typhosus*. The second attempt was successful, possibly owing to the fact that the fingers were thoroughly dried with a cloth, the mechanical friction apparently helping to remove the bacteria. Even if this were the case, it only means that the cloth became infected, and the danger of contaminated fingers remains obvious.

D. Survival in Food.

Milk Experiment I.—Placed 100 c.c. of fresh unboiled milk in each of two flasks, labelling them A. and B. respectively.

Flask B was then placed in steam at 100° C, for one hour, flask A being left unsterilized.

To each flask was added 0·01 c.c. of an emulsion of *B. typhosus* (strain F. I.), being the growth from a first subculture from a plate made from carrier F. I.'s urine. This emulsion, counted by plating, was found to contain 5,890 million living *B. typhosus* per cubic centimetre, so that the amount actually added to each flask was 58,900,000 *B. typhosus*, making a strength of 589,000 bacilli per 1 c.c. in each flask at the commencement of the experiment on January 15, 1912.

The flasks were left at room temperature for one and a half hours, and then their bacterial content enumerated by plating.

Result: *Flask A* found to contain—

B. typhosus, 4,580,000 per cubic centimetre.
B. coli, 2,750,000 " "
Flask B.—
B. typhosus, 3,440,000 " "

On January 16, 1912, the bacterial contents of the two flasks were again enumerated.

Result: *Flask A.*—

B. typhosus, 100,000 per cubic centimetre.
B. coli, 1,300,000 " "
Flask B.—
B. typhosus, 5,100,000 " "

On January 18, 1912, the examination was repeated.

Result: *Flask A.* No. *B. typhosus*, many *coli*.
Flask B.—*B. typhosus*, 90,000,000 per cubic centimetre.

It will be seen that in the foregoing experiment the *presence of* B. coli *in the unboiled milk was sufficient to get rid of, or at least outgrow* B. typhosus *in three days*. On the other hand, the *B. typhosus* grew and multiplied freely in the sterilized milk.

Experiment II.—Milk. Took a fresh unboiled sample of milk and examined its contents by plating. Result: *B. coli*, 15,500 per cubic centimetre. Other bacteria, 8,600 per cubic centimetre.

Immediately after plating the milk, 100 c.c. of the sample was placed in each of two flasks, labelled A and B respectively.

Flask A was left unsterilized.

Flask B was autoclaved for twenty minutes at 115° C. To each flask was added 0·001 c.c. of the urine of carrier F. I. This urine was found by plating to contain something over 3,000 million *B. typhosus* per cubic centimetre. The total number of bacilli added to each flask was, therefore, three million, making the strength in each flask at commencement of this experiment on September 26, 1912, about 30,000 *B. typhosus* per cubic centimetre. The flasks were left at room-temperature.

On September 27, 1912, the "content" of each flask was enumerated by plating.

Result: *Flask A.*—

Per cubic centimetre $\begin{cases} \text{\textit{B. typhosus}, 1,000 (? approximate)} \\ \text{\textit{B. coli} and others, 23,000,000} \end{cases}$

Flask B.—*B. typhosus*, 10,000 per cubic centimetre.

On September 28, enumeration showed:—

Flask A.—Innumerable *B. coli* and others.
No *B. typhosus*.

Flask B.—*B. typhosus*, 100,000 per cubic centimetre.

On October 1, 1912, enumeration showed:—

Flask A.—*B. coli* and others, 35,000,000 per cubic centimetre.
B. typhosus *could not be isolated.*

Flask B.—80,000,000 *B. typhosus* per cubic centimetre.

Flask B still contained enormous numbers of *B. typhosus* in pure culture on December 10, 1912, when last examined. There seems no reason why this culture should not remain alive indefinitely.

This experiment confirmed the previous one, in that *B. typhosus disappeared from the unboiled milk by the third day.* It had practically disappeared on the second day, but one colony happened

to be discovered on the edge of a "concentrated" plate and led to an approximation to a "count."

The inference is that unboiled milk must be consumed soon after contamination to be infective. Boiled milk might be very dangerous indeed if manipulated by a "carrier" subsequent to boiling. The probability of this occurring, is, however, not very great. The experiments have a decided bearing on the question of the sterilization of milk by heat.

Experiment III.—Soup. On September 26, 1912, 100 c.c. of soup freshly prepared from the "stock pot," was placed in a china bowl, no attempt being made to sterilize the bowl or to cover it from the air. The tip of the experimenter's right index finger was allowed to come in contact with the urine of Carrier A. (proved by plating to contain upwards of 3,000 million *B. typhosus* per cubic centimetre). The china bowl was then lifted in such a manner that the infected finger came in contact for a moment with the contained soup. The soup was left at room temperature with free access of air and dust to the open bowl. On September 27, enumerated the bacterial contents of the "soup." Result: *B. typhosus* was present apparently in pure culture, numbering 15,500 per cubic centimetre. The soup was now left until October 1, when it was found to be covered with a thick scum, and to have a sour and putrid smell. On plating and examining the soup as to its bacterial "content," no *B. typhosus* was isolated, but very many clear colonies partially acidifying lactose, and without any effect on glucose, were found on the plates. No attempt was made to further investigate these organisms owing to lack of time. The salient fact is, that *B. typhosus* had disappeared.

It is also to be noticed that disappearance was conditioned not by *B. coli*, but by some other organisms, apparently arriving in the broth from the air. The rapid multiplication of the *B. typhosus* during the first twenty-four hours leads us to believe that the contamination of soup might be a serious danger in an officers' mess, for example, where a "carrier" waiter might conceivably dip a finger in a tureen or plate.

Food Experiment IV.—Liver and Bacon. On September 26, 1912, obtained a portion of "liver and bacon" as served in an officers' mess. This was minced up and diluted with 60 c.c. of sterile distilled water, the whole being placed in a glass basin with a cover. The tip of the experimenter's right index finger was wetted with urine from Carrier A (the sample being proved to contain upwards of 3,000 million *B. typhosus* per cubic centimetre).

Afterwards, the contaminated finger was allowed to come in contact with the "liver and bacon" mixture, which was then kept at room temperature.

On September 27 the bacterial content of the mixture was examined by plating. Result: *B. coli*, 6,900 per cubic centimetre. Non-lactose fermenters, 54,700 per cubic centimetre.

The non lactose fermenters formed opaque colonies and did not acidify glucose. No *B. typhosus* was isolated from the mixture. On October 1 the mixture, which now smelt very sour and was almost solid from deposit of fat, was again examined. Result: Innumerable *B. coli*. A few opaque non lactose fermenters, no *B. typhosus*.

These experiments on the viability of *B. typhosus* in milk, soup, &c., enable us to form an idea of the conditions under which a "carrier" is likely to infect healthy persons through the manipulation of food. It is obvious that the contamination of food *before cooking* will usually be rendered harmless when the temperature of the food is raised. Contamination after cooking will be very dangerous even if the food is consumed immediately after the contamination takes place. The fingers of a typhoid carrier may be the vehicles of millions of germs. A single drop of urine—say 5 c.mm., or the two hundredth part of a cubic centimetre—may contain anything from a million to three hundred million typhoid bacilli, and these will multiply in soup at the temperature of serving. Again, soup contaminated, allowed to cool, and "warmed up" again to a temperature just pleasant for drinking, may be very dangerous, especially if the soup has been covered to keep out dust in the interim.

Milk puddings, prepared at a high temperature which will probably sterilize the milk, partly used, perhaps contaminated, and then set aside to be used cold later on, may be a source of extreme danger, as in them the *B. typhosus* will multiply rapidly. Milk boiled or "pasteurized," perhaps manipulated for an early meal, and then set aside as more likely to "keep" than unboiled milk, will be an ideal culture medium for the *B. typhosus*. We are inclined to regard the anti-typhoid activities of *B. coli* as one of the most important natural safeguards against enteric fever, but would again refer to the difficulty of *demonstrating the presence of B. typhosus* where it is co-existing with a large majority of *B. coli*. The possibility that a negative result in the search for *B. typhosus* may be due to limitations of technique must always be borne in mind.

(3) Means of Transmission from the "Carrier" to the "Recipient."

We do not propose to more than briefly consider this part of the subject, which alone is capable of furnishing material for several essays if treated fully. The preceding pages have all aimed at emphasizing the importance of "contact" in the spread of enteric fever, using the term, as does Simpson, "to include direct personal infection from close association, the infection of a commensal, and indirect infection through excreta." The importance now given to this mode of infection is largely owing to the researches of Reed, Vaughan, and Shakespeare already quoted. "Out of a total of 1,608 cases especially studied, and which were accurately located as to time and place," 35·01 per cent could be directly traced to contact, and 27·79 per cent were indirectly traceable to the same mode of origin—in other words, a total of 62·8 per cent of the cases studied were explained in the terms of "contact." *It must be remembered that every case traced to "contact" is traced to a "carrier," either acute or chronic.* When the above quoted observers made their celebrated investigation, the conception of the "chronic carrier" had not yet emerged, so that their 62·8 per cent of "contact" infections were presumably all traced to acute carriers. Now, Klinger dealing with 1,397 cases of infection traced to "contact," found that 125 or 8·9 per cent were to be traced to "chronic carriers," and this under the conditions of civil life. It is safe to assume that at least this number would have been traced to "chronic carriers" by Reed, Vaughan, and Shakespeare, had they been equipped with the knowledge which further investigation had placed at the disposal of Klinger. This would have brought their "contact" infections to over 70 per cent. But the rôle of "chronic carriers" will probably be found to be far greater in war than in peace. We propose to deal with this subject when we consider the "typhoid carrier" state, but we may here express our opinion that many persons who, under normal conditions, merely "carry" but do not "excrete" typhoid bacilli will, under the abnormal and exhausting conditions of war, become active "excreters" instead of passive "carriers." Taking the three mechanisms of infection included by Simpson under the name of "contact," direct personal infection will be likely to occur through interchange of articles of clothing, pipes, boots, &c., by fouling of the ground in the vicinity of tents, by urine, which will cause moist and infected earth to adhere to boots or gaiters with the possibility of being, later on, transferred to the mouth on the

fingers; and the "splashing" of urine on the boots and garments of persons using the urinals at the same time as, and in the vicinity of, carriers. The infection of commensals need not be enlarged upon. The risks are obvious and increase enormously if the carrier, instead of being merely a commensal, is actually engaged in the preparation or serving of food. Indirect infection through excreta, however, is probably the most important mechanism of the three. The close association of a high typhoid fever incidence with imperfect systems of sewage disposal is well known both in civil life and in the army under peace conditions. Pringle (" Public Health, London," 1902-3, xv), has shown that in fourteen towns with middens the typhoid rate per thousand was 0·25, while in fourteen towns where water-closets were used it was 0·19. In Birmingham (" Report, Health of Birmingham," 1906 and 1908), the incidence of typhoid fever in the "pail" and water-closet houses respectively was as 65 to 43. Dr. Deane-Sweeting, in an inquiry into the high typhoid incidence amongst colliery-workers at Leigh ("Report of the Medical Officer to the Local Government Board," 1907-8), found that the typhoid rate was four times as high amongst these workers as amongst the rest of the population, and attributed this fact to the filthy conditions of disposal of excreta in the mines. Army Medical Officers have frequently recorded evidence to the same effect, a good instance being that reported by Captain B. B. Burke, R.A.M.C. (" The Importance of Latrine Infection in the Spread of Enteric Fever," JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. iv, p. 46, 1905). Instances might be multiplied to the same effect. The point that we wish to emphasize is that in war, the danger from this source is likely to be immensely increased. The necessity for using trench latrines brings into prominence those three great intermediaries in the excremental contamination of food, dust, flies and water. We should prolong this Essay indefinitely were we to enter fully into these large questions. Suffice it to say, that we consider the work of Firth and Horrocks, of Neisser and others conclusive as to the danger of dust in the spread of *B. typhosus*, while the fly has been definitely incriminated by the work of many recent investigators, and may be regarded as one of the most serious factors in the contamination of food with the specific agent of the disease. We would again refer to our experiments upon the viability of the *B. typhosus* in food, especially where this has been previously cooked so as to sterilize it. Such cooked food if left uncovered, invites the attention of flies and provides an excellent medium for the multiplication of *B. typhosus*.

(4) Conditions Associated with the "Recipient" of Infection.

The importance of the "carrier" in the causation of infection will vary with the degree of susceptibility to the disease of the healthy persons in the vicinity. We are, therefore, obliged to deal briefly with this important question because our object is to demonstrate the enormously greater danger of the "carrier" in war than in peace; and we desire to show that, in respect of the relative susceptibility of the troops, war conditions tend to favour the spread of typhoid fever by "carriers." The influence of age and of length of service on the liability to enteric is well known, but there is much reason to believe that the essential point is *the length of service in infected localities.* Major (now Colonel) Simpson ("Report on the Prevalence of Enteric Fever in Pietermaritzburg appended to Army Medical Department Report, 1898"), dealing with the influence of service, shows that (1) "there is a great difference in the prevalence of enteric fever in units arriving from England, the Cape, and India; that the admission-rate in 4,232 men from England was 39·3 per 1,000, in 3,223 men from the Cape 33·2, and in 3,048 men from India, 23·6 per 1,000; that is, roughly the prevalence in Maritzburg is *inversely as the prevalence in their previous stations.*" Further he shows: (2) "That in 1888 and in 1889, when enteric fever was least prevalent, the garrison was composed of corps which had been at least two years in Natal; and, on the other hand, that an exceptional prevalence has been preceded by the arrival of fresh bodies of men." It would be impossible to make clearer the conditions which conduce to the relative susceptibility of bodies of troops. In war, it will always be necessary to use a large number of men who are at the susceptible age, whose period of service is short, and who have not previously served abroad. It may be assumed, then, that their susceptibility to the disease will be very great. Fatigue, hunger, and over-exertion will also lower the individual resistance; while the minor bowel complaints, incidental to life in camp, will bring about the "local" conditions most favourable to the maturation of the *B. typhosus*, should this organism gain access to the alimentary canal. At the same time these same conditions, affecting "carriers" who happen to be present amongst the troops, will lower their resistance, and lead to a greater excretion of germs. If it is desired to discover whether a person is a "carrier," or not, it is customary to prescribe a purge and then collect a specimen of the fæces for examination. The increased rapidity

of transit of the bowel-contents brings down the bacilli from the bile-containing areas of the intestine before the competition of other organisms in the large intestine has had time to mask the *B. typhosus*. A diagnosis is thus more easily made.

But an attack of camp diarrhœa should have the same effect. It is worth recalling that the diarrhœa rate usually rises before the enteric rate in armies in the field, a point especially noticed in the South African War (Simpson). This camp diarrhœa is likely to increase the excretion of germs by active "carriers" and to lead to the excretion of bacilli by persons who had previously been passive "carriers" only.

As to the causation of enteric fever we may then conclude :—

(1) That owing to service exigencies, especially the aggregation of men in barracks or camps, often in hot climates, the importance of "carriers" will be greater under army conditions than in civil life.

(2) That in war :—

(*a*) The excretion of germs by "carriers" will tend to be increased.

(*b*) The means of transfer of these germs to the healthy will be enormously facilitated, and

(*c*) The resistance of the individuals composing the forces will be below normal.

(*To be continued.*)

A REPORT ON TWO CASES OF ACUTE ANTERIOR POLIOMYELITIS THAT OCCURRED IN THE BRITISH TROOPS STATIONED AT PEKING.

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In the latter half of 1912 the spinal cords from two cases of acute anterior poliomyelitis were received at the Royal Army Medical College for microscopical examination.

Case 1.—The material for examination consisted of portions of the spinal cord and the brachial plexus preserved in Müller's fluid. This was accompanied by a letter and a statement of the case from Captain J. C. Hart, R.A.M.C., who desired that if of sufficient interest the case should be published in the Journal. I am much indebted to Captain Hart for permission to embody his notes in this paper. The clinical history of the case put as concisely as possible is as follows:—

Private H. L. C., Somerset L.I., aged 26. Service 11 years. Stationed at Fengtai, 15 miles from Peking, N. China. While on guard, August 9, 1912, he felt the right arm getting very weak, and when he tried to slope arms on going off guard he could not perform the motion.

There was no record of earlier symptoms, except that he had felt seedy and thought he had a little fever for two days before. He reported sick, and was admitted to Military Hospital, Peking, the same evening.

On admission: Temperature 101·4° F. He had severe headache, but no mental symptoms; complete paralysis of right arm, none of palate, tongue or lips, no rectal or bladder symptoms. Sensation for touch, temperature, or pain was not affected. Reflexes of eye normal, but knee-jerks were very exaggerated, especially on the right side.

Second day in hospital: Temperature 102°—104·2° F., pulse 88—100, respiration 32. About 6 a.m. he felt the left arm getting weak, and some bilious fluid was vomited during the night. General condition much the same as yesterday, but in addition there was distinct weakness of the left hand.

Third day in hospital: Temperature 100°—104·8° F., pulse 88—100, respiration 36—28. Paralysis of right leg was complete, but the left had perfect movement; knee-jerks completely gone from right leg and almost gone from left. There was pain on deep pressure over calf muscles of right leg and to a less degree of left,

but beyond this no sensory disturbance. In the afternoon both knee-jerks were completely gone, there was no clonus and no Babinski sign. There was slight difficulty in locating correctly a spot touched on the right hand. At 11.30 p.m. he had a respiratory spasm, and another during the night.

Fourth day in hospital: Temperature 102·8° F., pulse 88, respiration 28. At 7.20 a.m. he suddenly lost all power of speech, and had great difficulty in swallowing. At 7.45 a.m. he passed an involuntary motion, and on being turned over became cyanosed and the pulse became weak. He recovered when placed on his back. Unconsciousness then rapidly set in and he died at 8.55 a.m. The pulse remained fairly good till near the end.

Post-mortem Examination.—Contents of abdomen and thorax normal. Brain and spinal cord appeared normal to the naked eye, with the exception of some venous engorgement of the meninges. No signs of neuritis in the right brachial plexus.

Case 2.—The material for examination consisted of portions of the spinal cord, some preserved in glycerine and water and some in formalin. These were accompanied by a report by Dr. G. Douglas Gray, Actg. M. O. Brit. Legation Guard, Peking.

The following is a summary of Dr. Gray's notes:—

Private F. S. S., Somerset L.I., aged 23½, service 3½ years, stationed at the British Legation Guard, Peking. Admitted to Military Hospital, Peking, September 2, 1912.

Family history: Very good: brothers and sisters all alive and well.

Personal history: No entry on medical history sheet, healthy and regular life, total abstainer.

Onset of illness: Two days before admission to hospital he played football and felt a chill afterwards: then he was observed to be lying face down in the sun, and was checked for this. The following day he was out of sorts, but the day after paraded for medical inspection, when nothing was noted. Later in the same day he was admitted to hospital.

On admission: Temperature 103° F. He complained of feeling ill, but there were no symptoms. No physical signs, no splenic enlargement.

Second day in hospital: Temperature 103—104·8° F., pulse 120, respiration 40. There was marked lassitude, and towards evening slight motor paresis appeared in left arm.

Third day in hospital: Temperature 103—104·8° F. pulse 100—120, respiration 40—56. Paralysis of left arm was absolute; sensation unimpaired; knee reflexes varied; Babinski's sign was absent.

Left leg movements more sluggish than right; no pain, speech and memory not involved; tongue furred; more drowsy towards evening.

Fourth day in hospital: Temperature 103—101° F., pulse 108—84, respiration 56—40. Restless night; drowsy and torpid; paralysis the same; deglutition difficult; fæces and urine passed (?) involuntarily.

Fifth and sixth days in hospital: The same, except that torpidity was more marked.

Seventh day in hospital: Temperature 100—103° F. pulse 120—134, respiration 56—68. Pain on movement of left elbow; general debility increasing; pulse weaker; respirations quick and shallow; crepitant râles over both lungs; intelligence brighter.

Eighth day in hospital: Gradual accentuation of symptoms. He became comatose, and died at 4.5 p.m. on September 8.

Additional Notes by Dr. Gray.—The clinical picture in many respects was that of rabies. As torpidity increased there was urinary and rectal involuntary movement, but the sphincters remained active to the last.

Blood count: Red blood corpuscles 5,000,000, white blood corpuscles 10,500. Polynuclears 67 per cent, lymphocytes 23 per cent, large mononuclears 8 per cent, eosinophiles 2 per cent, myelocytes and basophile cells absent.

Post-mortem Examination held the following morning. There was congestion of all the viscera and a deeply congested area of meningeal membrane between the 4th and 6th dorsal vertebræ. The cerebrospinal fluid was clear. On section of the cord the anterior cornua were seen to be of a light pink colour, equally on both sides.

Histological Pathology.

I now proceed to describe the lesions observed in the cords.

Case 1.—Selected portions of the cord were embedded in paraffin and stained with the following stains—Weigert and van Giesen, hæmatin and eosin, Leishman, polychrome methylene blue and toluidin blue. Other portions were treated by Marchi's method (osmic acid), before embedding, to demonstrate any degeneration of nerve tracks.

The portions of the cord examined were as follows: About the 3rd, 6th and 7th cervical nerve roots, the 8th and 12th dorsal and the 1st lumbar.

In all regions there was intense engorgement of the blood-vessels, but chiefly of the anterior median artery and its branches (the anterior and posterior central) supplying the anterior and lateral horns of grey matter.

These vessels also showed marked perivascular infiltration of small round cells.

The grey matter was the seat of numerous hæmorrhages, most marked and very extensive in the region of the lateral horns in the cervical region, and to a less extent in the anterior and posterior horns.

In the dorsal region the hæmorrhages were most marked in the anterior horns, but also invaded the central grey matter and Clarke's columns. The hæmorrhages into the anterior horns arose from the terminals of the anterior lateral arteries (fig. 2).

In the lumbar region the hæmorrhages were situated particularly in the lateral horns and to a slight extent in the anterior.

The nerve-cells of the grey matter showed all stages of degeneration in and about the areas of hæmorrhage and their axis-cylinders were varicose. The most marked degenerative changes were seen in the right cervical region, those in the left appeared to be less advanced. The right lateral horn in the region of the 12th dorsal or 1st lumbar nerve roots was somewhat shrunken.

In the cervical region the majority of the cells were in an advanced state of degeneration, there was almost universal disappearance of Nissl's granules, the cells were pale and swollen and the nucleus was displaced to the side. Many of the cells contained clumps of pigment granules. In places round about the areas of hæmorrhage, and chiefly in the lateral horns, there was evidence of phagocytosis of the nerve-cells by large mononuclear cells (macrophages). These cells, as well as being scattered singly throughout the grey matter, might be found in clumps or columns, the shape of the mass suggesting the former situation of a nerve-cell now phagocyted. The presence of pigment granules, similar to those noted above, in these large mononuclears was taken to be direct evidence of their phagocytic activity.

The white matter in the cervical region showed tracts of degeneration on the right side. These tracts correspond to the direct cerebellar tract and to the posterior portion of the ascending tract of Gower, which derive their fibres from the cells of Clarke's column and the lateral horn respectively.

No bacteria were found.

Case 2.—Some of the portions of cord forwarded for examination had been preserved in formalin, and others in 50 per cent. glycerine, the latter for the purpose of animal inoculation; this, however, was not attempted.

Sections were prepared and stained as in Case 1.

The following portions of the cord were examined: About the level of the 4th, 7th and 8th cervical nerve roots, the 2nd, 6th and 12th dorsal and the 1st lumbar.

The most marked feature was the difference in size between the two sides of the cord; the left side in all the sections examined was smaller than the right. The difference was most evident in the lower cervical and mid-dorsal regions, and was due to a shrinking of the white matter, though the grey matter also suffered.

In the white matter the condition was limited almost entirely to the anterior and lateral columns. The vessels supplying these parts—the anterior root arteries, and the anterior, the median and the posterior lateral arteries—were dilated and surrounded in places by infiltrating mononuclear cells; round about their terminal branches there was an overgrowth of interstitial tissue which apparently had contracted and so caused distortion of the grey matter. This was very pronounced on the left side.

In the grey matter the most advanced changes were seen at the junction of the lateral and the posterior horns. These changes consisted in degeneration and lysis of the nerve-cells, an infiltration of large mononuclear cells and a considerable amount of sclerosis and contraction, which was particularly well marked in the cervical and mid-dorsal regions. The same changes were noticed to a less degree at the internal edge and the tip of the anterior horn, and also in relation to the terminals of the lateral arteries. With the exception of the posterior horn the whole of the grey matter of the left side showed considerable shrinking. As a result of this shrinking combined with the sclerosis of the white matter, a curious distortion effect had been produced in the lower cervical region, which will be best appreciated by a reference to the plate (fig. 1).

It may be stated then that the grey matter on the left side of the cord supplied by the anterior and posterior central arteries, and particularly the areas related to the terminal branches of the lateral arteries, was most affected and was probably the site of the earliest lesions.

The blood-vessels on both sides of the cord were engorged, but did not show perivascular infiltration to any marked extent, though the perivascular spaces were evident. In the mid-dorsal region one of the lateral branches of the anterior central artery, passing through the anterior column of white matter to the internal aspect of the left anterior horn, was packed with white cells chiefly polynuclears; the terminals of this artery corresponded to a well-marked area of infiltration in the grey matter.

Hæmorrhages were not a marked feature, but were present at the level of the 4th cervical vertebra on the left side situated at the roots of the posterior and anterior horns; also on the right side at the level of the 7th to 8th cervical, situated at the root of the lateral horn.

Alteration in the cornual cells consisted in partial or total disappearance of the Nissl granules (chromatolysis), swelling of the cell and displacement of the nucleus to one side; in places where one expected to find cells there were aggregations of large mononuclear cells. These changes were not confined to any one special group of nuclei, nor even to one side of the cord, indeed the right side was almost as much affected as the left.

Areas of infiltration of large mononuclear cells were also present on the right side, and corresponded in their position more or less to those already described on the left.

No tracts of degeneration were detected in the white matter.

No micro-organisms were found.

Remarks.

The following comments are suggested by these cases. As far as I am aware these are the first cases of acute anterior poliomyelitis in adults reported from China, certainly they are the first noted in the British troops. Captain Hart tells me that other cases have recently appeared amongst other European troops at Pekin, and I understand that an attempt is being made to collect particulars of all these cases. The information so gathered should be extremely interesting and should be valuable from an epidemiological point of view.

In a recent paper Flexner points out that this disease is pandemic, though only recently recognized as such, that it has been known to be endemic for many years in Northern Europe, but particularly in Norway and Sweden, where recently (1911 particularly) it has taken on a new activity, that five years ago it started to go round the world, and has been carried by immigrants (chiefly Scandinavians) to the United States and to Canada, where it has prevailed since 1907. It would be interesting if some such line of communication were traced to China.

In considering the epidemiology of this disease the following facts, the result of recent investigations, may be emphasized.

There can no longer be any doubt as to the infectious nature of this disease, and the danger of direct infection is greatly increased by the occurrence of cases which are clinically atypical

(viz., meningeal, abortive), also by the fact that healthy persons ("carriers") may harbour the virus.

The virus, which is one of the ultramicroscopic filter passers, has a remarkable vitality, and is highly resistant to drying, the action of daylight, chemical action, and to low temperature. It will survive in the dust of rooms for weeks or months, and monkeys have been infected by means of the dust collected from an infected dwelling.

The virus is found in the spinal cord and brain, the mesenteric lymph nodes, and the mucous membrane of the nose, throat, stomach and intestine, and is excreted by the nose and throat and the intestine. Infection can be produced in monkeys through the unbroken nasal mucous membrane, but not through the unbroken skin. When injected into the peripheral portion of a large nerve, e.g., sciatic, the virus proceeds up the nerve trunk to the cord, where the characteristic lesions are produced.

The possibility of insect carriers has been suggested because of the seasonal incidence (July to September). So far it has not been found possible to infect mosquitoes or lice, but the virus survives in the house-fly, and remains living and virulent for many days in the bed-bug. Rosenau has infected *Stomoxys calcitrans* by feeding on infected monkeys, and has transmitted the infection to fresh monkeys. In this connection Captain Hart tells me that he inspected the barrack-room in which the second case occurred, and found the joints of the beds swarming with bugs.

Vaccination (scarification) with the virus produced no result, but when cowpox was added and a typical pustule was produced, systemic infection resulted.

It has been noted in some outbreaks that a coincident disease has appeared in certain domestic animals, notably hens and dogs, which become paralysed. Though transmission experiments have not been successful so far, this observation merits further investigation.

From a clinical point of view these cases present a remarkable similarity, the only important difference being that the first was so very acute and reached a fatal issue on the fourth day. In both cases the paralysis first appeared in an upper limb, and later involved the leg on the same side. In adult poliomyelitis it is perhaps more usual for the paralysis to appear first in the lower limb and ascend to the upper (cf. Landry's ascending paralysis). There seems no doubt that in both cases the respiratory nuclei were involved.

The microscopical appearances, however, do not present such a similarity, and the differences would not appear to me to be explained merely by the duration of the disease in each case. The histological pathology has been closely studied in experimental monkeys by many investigators. According to Levaditi the course of events is as follows: In the acute stage there is an accumulation of lymphocytes and a few polynuclears along the lymphatic sheaths of the vessels of the white matter, particularly along the anterior septum; an infiltration of polynuclears and mononuclears into the anterior horns and around the central canal; an engorgement of the blood-vessels and hæmorrhage into the grey matter, chiefly of the anterior horns. The nerve-cells early begin to show signs of degeneration, as evidenced by the fusion of Nissl's granules and the diffuse coloration of the protoplasm. Then polynuclears and large mononuclears (macrophages) accumulate round the nerve-cells, and the neuron is destroyed.

It seems probable that the polynuclears cause solution of the protoplasm by a proteolytic ferment, and the macrophages phagocyte the debris. It follows, therefore, that in the place of the nerve-cells there is a group of white cells, partly degenerated, suggesting the form of the original nerve-cell. After the acute period the polynuclear infiltration disappears, the macrophages are left dispersed throughout the grey matter or accumulated round vessels. Finally a scar is formed, in the centre of which no nerve-cells are found.

The histological picture presented by Case No. 1 corresponds in every essential with the above description of the acute stage, but one or two points merit attention. The scarcity of polynuclears was very noticeable; this point has been emphasized by Flexner, who considers it to be in favour of a protozoal agent being the cause of the disease. Hæmorrhages were a very marked feature of this case, even extending into the posterior horns, and they arose not only from the branches of the anterior median, but also from arteries passing through the white matter, e.g., anterior and posterior lateral and the root arteries. It is interesting to compare the report by Collin and des Cilleuls of a case in an adult, aged 21, that ended fatally on the third day. They state that there was great venous and capillary engorgement, and the white matter was equally congested with the grey; in *no* part was there exudate, interstitial hæmorrhage or leucocytic infiltration of sheaths; the nerve-cells were still normal or showed only a degree of hyperchromatosis, though in the lumbar region more advanced chromato-

EXPLANATION OF PLATE.

Fig. 1.—Case 2: Section of spinal cord at level of 7th to 8th cervical nerve roots. Hæmatin and van Giesen. Showing the shrinking of the white matter and the distortion of the grey matter on the left side. Sclerosis ("Sc") of area supplied by the posterior lateral artery ("P.L.") and round about the terminals of the anterior root artery ("A.R."). Hæmorrhage ("H") in the right anterior horn.

Fig. 2.—Case 1: Section of spinal cord about the level of the 8th dorsal nerve root. Hæmatin and eosin. Showing extensive hæmorrhage into the left anterior horn arising from the anterior lateral artery ("A.L."). There is round-cell infiltration of the whole of the anterior horn and destruction of the cornual cells, of which only two remain visible ("N"). (The dark irregular spots are chrome deposits in the section.)

Fig. 3.—Case 2: Section of spinal cord in the upper dorsal region. Leishman stain. Showing contraction of the white matter of the left side and sclerosis round about the terminals of the lateral arteries ("P.L." & "A.L.").

Note in figs. 1 and 3 that the contraction of the white matter is limited to the anterior and lateral columns only. The difference in size between the right and left anterior columns is very marked.

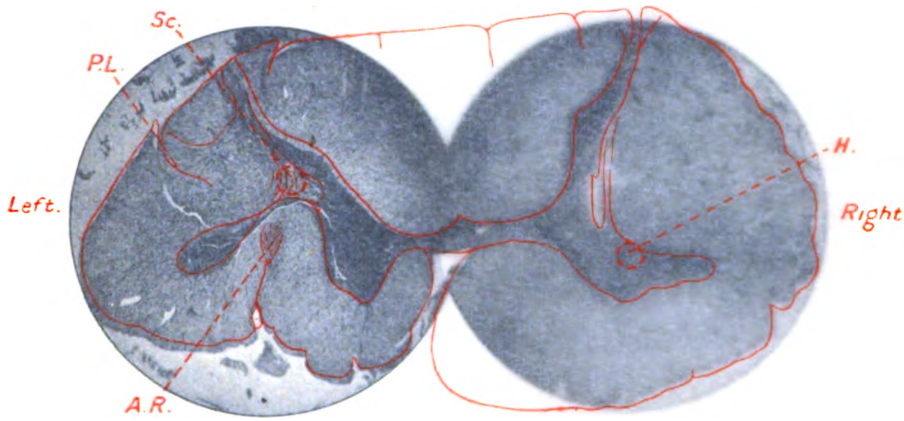
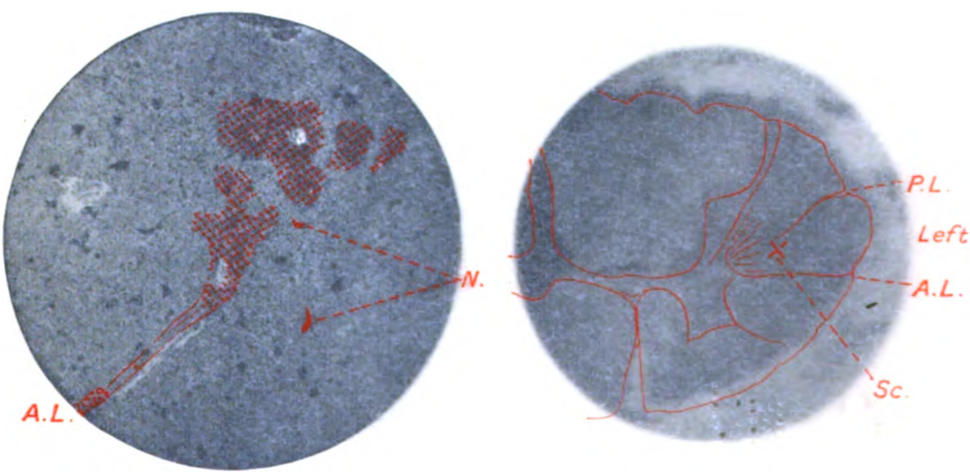


Fig. 1



To illustrate "A Report on Two Cases of
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By Major J. C. K

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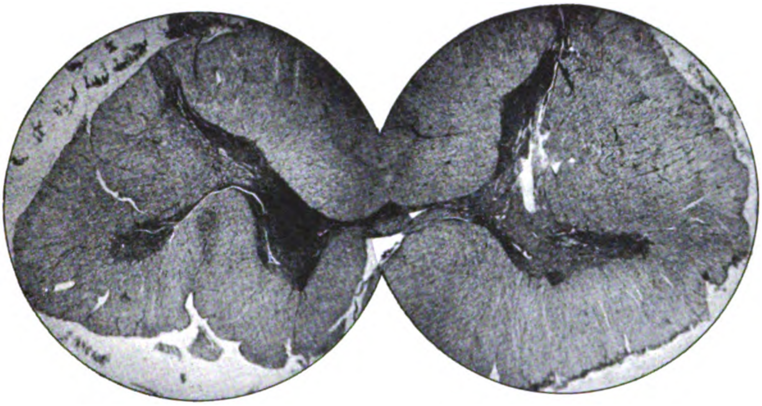

FIG. 1.

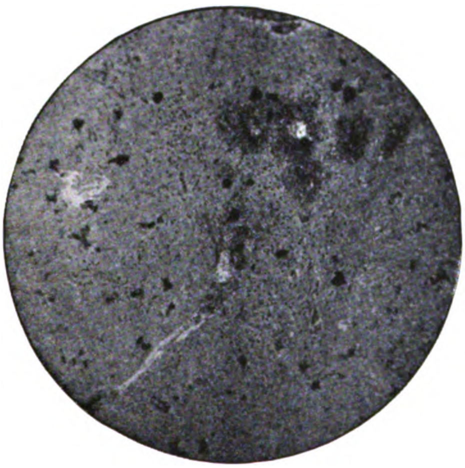

FIG. 2.

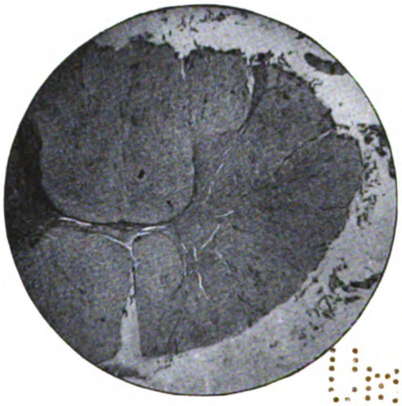

FIG. 3.

To illustrate "A Report on Two Cases of Acute Anterior Poliomyelitis that occurred in the British Troops stationed at Peking."

By Major J. C. KENNEDY, R.A.M.C.

lysis had commenced. They believe that the vascular phenomena (engorgement) alone are the first stage, and that the infiltration of the sheath is a later manifestation. However that may be there seems no reason to doubt that variations in the virulence of the virus may cause differences in the histological appearances. The virus has an affinity for nerve tissues, and as Flexner points out may select for its attack one constituent in particular, with the result that in any given case either the nerve-cells, the meninges, the blood-vessels, or the supporting tissues may suffer most.

With reference to the degeneration of the fibres of the antero-lateral column, Mott reports a case of a child of five months, who died on the sixteenth day, and showed a marked degeneration of the direct cerebellar tract on both sides.

Now let us look at the second case. Here we have a degree of engorgement, but only a moderate degree of hæmorrhage, a comparative absence of perivascular infiltration, a well-marked mononuclear infiltration of the grey matter, but not so extensive nor so advanced degeneration of the nerve-cells as in the first case, and an extraordinary degree of sclerosis and shrinking of the white matter and distortion of the grey. Such marked sclerosis would appear to be out of proportion to the duration of the disease. Here then we have a somewhat different picture to that presented by the first case. In the latter the predominant features are the hæmorrhages and the degeneration and phagocytosis of the cornual cells, in the former the sclerosis.

These two cases would therefore appear to afford an example of the variation in the selective action of the virus.

Cases of acute anterior poliomyelitis which end fatally in the short space of four or eight days, are not very common, and for this reason alone it would seem well worth placing them on record.

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United Services Medical Society.

THE DUTIES OF A R.A.M.C. OFFICER ATTACHED TO AN INFANTRY BATTALION ON ACTIVE SERVICE AGAINST A CIVILIZED ENEMY.

By Major H. ENSOR, D.S.O.

Royal Army Medical Corps.

The object of the paper which I have the honour of reading before you to-day is to direct attention to the duties which fall to officers of the R.A.M.C. when they are attached to an Infantry Battalion in time of war with a view to promoting a discussion on the more important aspects of the regimental medical service of fighting units on active service. I have chosen an infantry battalion for this purpose as it is the largest regimental unit in the British Army, and on infantry, as a rule, falls the largest share of the losses from disease and the enemy. Moreover, what is true of an infantry battalion applies, for the most part, with equal force to all other units of our Army when on active service.

The duties in question may be conveniently considered under three headings:—

(1) During mobilization.
(2) In camp and on the line of march.
(3) In action.

(1) Duties during Mobilization.

The R.A.M.C. officer will join the battalion to which he has been posted on the first day of mobilization, and will on arrival report himself to the C.O., and take over medical charge of the unit. His next care should be to arrange with the Adjutant the hours at which the sick are to be seen, and to ascertain what are the arrangements for the disposal of men who may be in need of hospital treatment. Having done this he should then inquire if the medical equipment of the battalion has been received. This equipment is despatched to the battalion, without [indent on the first day of mobilization by those responsible for its custody in peace time, addressed to the officer in medical charge, and consists of the following articles:—

One pair of field medical panniers.

One medical companion.
One surgical haversack.
Two water-bottles.

When this equipment has been handed over to him the contents of the panniers, &c., should be carefully checked for the double purpose of bringing to light any deficiencies or breakages, and of becoming acquainted with the contents, and noting where each article is to be found. The medical equipment of a battalion is a remarkably good one, and contains everything that an officer who knows his work can reasonably require. It used to be quite common on service to hear the whole equipment sweepingly condemned as useless by some junior fresh from a medical school because it did not happen to contain the latest novelty in antiseptic dressings, &c. The proverb about bad workmen and their tools should be borne in mind.

Arrangements should then be made for the inspection of other equipment which, although not officially described as medical, may be considered as such. I refer to the eight stretchers and two water filter carts which belong to each battalion, and it will also be advisable to see that the Maltese cart, which will, on the march, carry the medical equipment and stretchers, is in good order. If the stretchers have not already been marked with the name and number of the battalion, this should be done. Having inspected his *matériel*, the R.A.M.C. officer's next care should be the personnel which will be under his orders, and he should arrange to inspect the N.C.Os. and men who constitute the battalion's medical establishment.

It consists of the following :—

R.A.M.C.—One corporal and four men for water duties. These men join the battalion on the first day of mobilization.

From the battalion.—One lance-corporal as orderly to the officer in medical charge. One private to drive the Maltese cart, sixteen stretcher-bearers, two per company. One N.C.O. and eight men who form the regimental sanitary detachment.

In addition to these men each infantry battalion possesses a chiropodist, who is usually a N.C.O. not above the rank of serjeant.

The R.A.M.C. personnel for water duties should be tested as to their knowledge, and the best way to do this will be for them to filter water under the medical officer's personal supervision. Both carts should be used, and such a procedure will prove not only whether the men know their work, but also whether the filtration apparatus is in working order, or in need of repair. It should never

be taken for granted that a filter water cart is in good condition. If defects appear after the unit has taken the field it may be difficult, or even impossible, to remedy them for some considerable time. The stretcher-bearers should be put through an examination in stretcher drill and in first aid, especially with regard to the application of the first field dressing. Their knowledge with regard to these matters will probably not be found to be great, and permission should be obtained from the C.O. to instruct these men daily during the period of mobilization, and afterwards whenever opportunity offers. The corporal R.A.M.C. should attend these lectures, and act as an assistant instructor. Personally, I believe that if all these men acquire a thorough knowledge of first aid, particularly in the art of properly applying a first field dressing, they will be of incalculable value during an action. A first field dressing early and skilfully applied to a wound is the greatest, and indeed the only, safeguard we possess against that wound becoming septic.

The regimental sanitary detachment may have to be considered as being thoroughly conversant with their duties. During mobilization there will probably be no opportunity of testing their knowledge unless the battalion is under canvas. At any rate, it may be assumed that all have gone through a special course of training.

Another duty will be the careful medical examination of the reservists, and perhaps of the serving soldiers also, if this has not already been done. This examination must be carried out with the greatest care and thoroughness, and all men found unfit should be rigorously rejected for active service. At the place of joining on mobilization, reservists are subjected to a preliminary medical examination before they are clothed and equipped, but to avoid delay it is ordered that this examination is to be superficial in character. It is after they have joined the ranks of the unit to which they belong that they are to be thoroughly examined by the officer in medical charge of that unit. A man unfit for active service, if he escapes notice and proceeds to the front, is sure, sooner or later, generally sooner, to go sick, and be a useless encumbrance to the force to which he belongs. Nothing puts so great a strain on men as the conditions which obtain during a campaign, and no soldier who is not thoroughly sound has any chance of lasting out even for the first few days. Our soldiers, to their credit, are very keen on the prospect of active service, and to be found medically unfit is a great disappointment to them, but nevertheless, no point should be stretched in favour of men who are likely to break down under the stress of active operations.

It would be well also to direct the Adjutant's attention to the importance of inspecting the first field dressings and identity disks to ensure that no officer or man takes the field without them.

I now come to the second heading:—

(2) Duties in Camp and on the Line of March.

We will take the duties in camp first. The most important of these is the supervision of the sanitation. Field Service Regulations, Part II., Chap. XI., paras. 83 and 84, lay down that the commander of every unit is responsible for its sanitation and also for the sanitary condition of any area it may occupy, irrespective of the period for which it may be occupied. The R.A.M.C. officer attached to the unit is responsible to the C.O. for the efficient performance of the work of the regimental sanitary detachment; while the C.O. is responsible that all ranks give every assistance to the medical officer in carrying out his sanitary duties, and obey all sanitary rules. The importance of sanitation in war is enormous, and the responsibility of the C.O. and the battalion medical officer to their country with respect to this matter is equally great.

It is only by efficient sanitary measures that we can hope to avoid the great loss which disease has up to the present invariably caused to armies in the field. One of the principal duties of the R.A.M.C. officer will then be the personal supervision of all necessary sanitary measures.

I will begin with the duties in connexion with the sanitation of a battalion in standing camp, and perhaps it may be as well for me to state what I mean by "standing camp." My definition of the term is that a camp should be considered as "standing" when the troops have been in occupation of it for twenty-four hours, and no orders have been issued for them to move.

After the expiration of twenty-four hours, in the event of there being no orders for the battalion to move, the area on which it is encamped should be considered as an area which is likely to be occupied by the unit for some considerable time, and the somewhat primitive system of sanitation, which necessarily prevails when a battalion is bivouacking for the night, changed for the more elaborate one necessary for a standing camp. A mistake which is often made is to neglect the necessary sanitary work in the expectation that orders may arrive for the troops to move almost immediately, and, as a result, it often happens that the men are allowed to remain in unsatisfactory sanitary surroundings for

three or four days before the camp is put into a thoroughly healthy condition.

The sanitary measures necessary in camp are fully detailed and described in R.A.M.C. "Training" and in the "Manual of Elementary Military Hygiene," and there should be no difficulty in keeping a standing camp clean and in a good sanitary condition if the medical officer is zealous, and if the C.O. of the battalion gives him every assistance.

The N.C.O. and eight men who are trained in sanitary duties are to be employed on all work in connection with latrines, refuse disposal, &c., but it must not be supposed that these men will be able to carry out all the hard manual labour which the efficient sanitation of a camp entails. Fatigue parties with a sufficiency of tools must, when required and available, be provided by the C.O. of the battalion, and placed at the disposal of the R.A.M.C. officer for carrying out measures he may think necessary. I have said before that there should be no difficulty in keeping a standing camp in a good sanitary condition "if the C.O. gives every assistance," and, I should like to add, if the battalion is in a good state of discipline. The sanitary condition of a camp is perhaps the best criterion one has of the state of discipline of the troops occupying it.

The sanitation of a battalion in bivouac is a much more difficult one. If the battalion is one of the twelve contained in a Division, and the Division is marching as a division, the D.A.D.M.S. of the Division will advise, from the sanitary point of view, the staff officer detailed for the duty of the selection of sites for camps and bivouacs. He will probably be able to do this if the Division is marching in column of route by one road; but it seems to me hard to believe that he will have time to do so, considering the other duties for which he is liable, if the Division is moving by several roads in a friendly country, and it will be manifestly impossible in a hostile one if in touch with the enemy. Therefore, occasions will frequently occur when the R.A.M.C. officer of the battalion will be called upon to advise on the selection of these places, and to ensure that the orders with regard to water supplies are obeyed. This should be his first duty; the next will be to see that the R.A.M.C. detachment are at their work of filtering water for issue to the troops, and then sites for the cooking of food, latrines, urine pits, &c., should be selected.

All this is very easy to say, but I think that all those who have had experience of war will agree with me that it is most difficult

to get carried out efficiently. The men are tired, as a rule, and very often hungry and thirsty—more especially thirsty—and it is difficult to prevent them drinking the first water to which they come. Latrines also under such conditions are likely to be of a most primitive description unless the men told off to dig them are personally supervised. However, in such a case the R.A.M.C. officer must do the best he can, and must, if necessary, insist on his orders being carried out, and not content himself with merely giving orders to the sanitary detachment, and taking no further concern. It is unpleasant to drive tired men, but it must be done. Sometimes on the march, particularly on night marches and those which extend into the night, sanitation is practically impossible. All that can be done is to allot an area of ground for the men to make use of in lieu of latrines, and issue orders that all excreta are to be covered up. This system is, I believe, the oldest form of camp sanitation of which we have any record. It is laid down in Deuteronomy xxiii, 13, for the guidance of the Hebrews; and I have no doubt that Joshua had a short way with the disobedient.

An important duty which will, in my opinion, often be neglected unless insisted upon is the cleansing of the bivouac area before starting on the march the next day. Latrines must be filled in and marked, and each company made to collect the refuse in its lines, and burn or bury it. The area which has been used will very probably be again occupied by other troops, and it will be disgraceful if they are allowed to run the danger of contracting disease through idleness or carelessness on the part of the unit which preceded them. The sanitation of billets in war is one of which I have no personal experience. When troops are in close billets in country places where no water carriage system exists, company latrines will most certainly have to be dug, as the sanitary conveniences of the inhabitants will be inadequate.

The next of the many medical duties with a battalion is the care and treatment of the sick.

When the battalion is in standing camp, the sick should be seen twice a day at the hours arranged by the A.D.M.S. of the Division, and notified in routine orders, or, if no orders have been issued with regard to this, at hours agreed upon by the R.A.M.C. officer and the Adjutant.

Officers and men who are, in his opinion, too ill to remain with the battalion are to be sent to the field ambulance detailed for their reception. The duty of conducting them there will, as a rule, fall on the battalion unless other arrangements have been made by the A.D.M.S.

At sick parades the very greatest care must be taken to examine every one carefully, and, except in minor surgical cases, the temperature should invariably be taken. It is a most difficult question to decide whether to send a man to the field ambulance, simply because he is suffering from a moderate degree of fever. The R.A.M.C. officer must try to prevent the weakening of the strength of his battalion by every means in his power, and he must remember that cases which are sent to a field ambulance are evacuated to the lines of communication on the first opportunity, and that a man who has been sent down may take a very long time, even if his complaint was trivial, before he returns to duty with the battalion. Personally, in standing camp I should be inclined to make arrangements for keeping mild febrile cases with my unit for forty-eight hours, isolating them as much as possible in tents or shelters, and I would only send them before the end of this period to the field ambulance for disposal if orders for marching were received, or if observation of them made it appear probable that they were suffering from some definite illness. The greatest care must, of course, be taken with regard to the disposal of the fæces and urine of such cases, and they must always have separate latrine accommodation, and under no circumstances be allowed to make use of that provided for the unit. Every case of fever in a non-malarious country should be regarded as possibly one of enteric, and precautions taken accordingly.

It should always be borne in mind that when a man has been sent to a field ambulance, and sees sick constantly being transferred to the comparative luxury and ease of the L. of C., it is a temptation to him to make the most of his ailments so that he may also, for a time at least, escape the discomforts of service in the field.

This brings me to the question of what is usually known in the Army as "malingering," but which should, in the vast majority of cases, if the section of the Army Act dealing with the subject be considered, be called "feigning disease." That some men, happily few in number in our Army, do report sick in war time in the hope of being sent down to the L. of C. from the front is a fact which I think few of our officers, with war experience, will deny. In my opinion, it shows a want of knowledge of human nature not to expect to meet with such cases.

Any tendency to such a practice should be checked by careful examination of all men reporting sick, and in all cases in which it is clear that a man is feigning disease the word "duty" should

be written on the sick report, so that the offender may be dealt with and punished by his C.O. If a medical officer, through faulty judgment, weakness, or good nature, allows a man to leave the ranks unless too ill to stop in them, he is guilty of not doing his duty to the State. A good officer will very soon get to know who are the men inclined to report sick without cause, and in cases of doubt it is a good plan to ask the colour-serjeant of the man's Company, in the man's presence, what sort of character the man bears. Most N.C.Os. I have met have not been at all backward in stating what they believe to be the truth about such cases. The N.C.Os. of our Army are intelligent, and are in a position to know which of their men sleep and eat well, and only get a fit of the "trembles" when a job of work is to the fore. It is, I believe, a maxim in law that it is better that ten guilty persons should escape justice than that one innocent man should suffer. War is so much more serious a question, and the issues at stake so much greater, that, in my opinion, it is better that very rarely an innocent man should be punished than that the ranks should be depleted, to no matter how slight an extent. With care, however, it is very unlikely that innocent persons will suffer, and a man who is suspected of reporting sick without a cause other than the ignoble one of avoiding the dangers and discomforts incidental to active service, can always be warned before he is reported for punishment.

After a man has been reported the question of punishment is a matter for his C.O., but in a good, well-disciplined battalion it will be of such a nature as to act as a very real deterrent to the man and to others.

When the battalion is marching every day the daily sick should be seen in the evening, if possible about two hours after the halt for the night. The reason for this delay is that, in some cases, especially among unhardened troops, the result of a long and arduous march is the raising of the body temperature. If such men are seen immediately, or soon after the end of the day's march, it might appear that they were really seriously ill, whereas in an hour or two their temperatures will have fallen to normal, and the possibility of error thus avoided. Men unfit to remain with the battalion will of course be sent to the field ambulance detailed to receive them. On the march, febrile cases, in my opinion, should not be allowed to remain with the battalion, but should be sent to the field ambulance at the earliest opportunity. A man suffering from fever is not in a fit condition

for an exhausting march, and if the practice be followed of keeping such men in the ranks in the hope of their recovery, most of them will infallibly fall out after a few miles the next day.

Falling out on the line of march should be guarded against as much as possible, and the keeping of sick men in the ranks does not do this, as the example of men unavoidably falling out is only too often followed by indifferent soldiers, who will not be ashamed of trying to obtain a lift in the ambulance wagons if they see others doing so. It can, to a certain extent, be checked by taking care that really sick men are not called upon to march, but the most important matter of all with regard to this question is the proper care of the soldiers' feet. This is now, I believe, one of the duties of Company officers, but the R.A.M.C. officer should attend feet inspections as often as possible, and be ever ready to advise and help the battalion chiropodist. It will probably be found that at the beginning of a campaign the reservists are the men who most frequently fall out, and this is not to be wondered at, considering that they may have for the previous three or four years, or longer, been living the life of civilians, and have become unaccustomed to the weight of their arms and equipment. Every care should be taken of these men, and if it is seen that any of them are becoming exhausted, they should be given a note permitting them to ride in an ambulance wagon. When the reservists have become hardened, which they will be in a week or two, they will be among the best men in the battalion, as they are as a rule older than the serving soldiers, have attained their full strength and development, and are in consequence capable of standing more hardship.

We will now consider the third heading, viz. :—

(3) Duties in Action.

I propose to deal with the duties only in the three following situations:—

(*a*) When the battalion is on the defensive holding a prepared position.

(*b*) When engaged in an attack.

(*c*) When engaged in an encounter battle.

(*a*) With regard to the first, in this case arrangements for the disposal of wounded can and should be made beforehand, and regimental aid posts should be established in suitable places and their position made known to the troops and to the O.C. Field

Ambulance, allotted by the A.D.M.S. to the section of the defence in which the battalion is posted. These aid posts should be as near as possible to the trenches held by the battalion, and, personally, I think should not exceed three in number. When locating them every advantage should be taken of natural cover increased by artificial means, such as walls of loose stone and earth built up more or less parallel to the line held by the battalion. The wounded should, as far as may be possible, be laid lengthways with these walls, so as to diminish the possibility of further injury from shrapnel; unless the position is enfiladed they will be almost quite safe from rifle fire, but it would be wise to guard against enfilading fire by building short high walls at right angles to those parallel with the trenches. These aid posts should be reached by the stretcher-bearers carrying the wounded, when opportunity offers, along tracks marked out beforehand as affording the maximum amount of shelter. Buildings should not, as a rule, be made use of as aid posts; they attract the enemy's artillery fire.

A water-cart should be allotted, if the C.O. approves, to each of the aid posts on either flank, and the Maltese cart to the third, central one. The animals for these vehicles should of course be withdrawn to a safe distance, but the R.A.M.C. officer should know where they are so that they may be available in the event of the battalion advancing after a counter-attack has been delivered with success.

Assuming that the water-carts have been brought up, the R.A.M.C. personnel should occupy the aid posts, and thus with the orderly in charge of the Maltese cart there will be two men trained in first aid at each post.

The regimental stretcher-bearers with their stretchers, but without their arms and ammunition, should remain with their companies and render first aid to the wounded, and when occasion offers remove those too seriously injured to continue fighting to the aid posts, and then return with their stretchers. It must be understood by them, however, that during the height of an attack, when the enemy's infantry is being vigorously supported by artillery fire, nothing should be done beyond rendering first aid. The R.A.M.C. officer with his orderly lance-corporal, should, for the most part, remain in the trenches during the action, and move up and down the position as much as possible. He will, by so doing, be able to see that the regimental bearers are carrying out their duties, and will be able personally to give first aid to the greatest number. There is no doubt also that the *morale* of the troops is much influenced for good by seeing him among them.

In the event of a successful counter-attack being delivered, and the battalion ordered to advance in support, the R.A.M.C. officer with the regimental bearers must follow the advance, but the stretchers themselves should be left in the trenches, the corporal R.A.M.C. having beforehand been given orders in such an eventuality to collect the stretchers, load them on the Maltese cart, and send the cart itself forward as soon as the horses can be run up and harnessed. The reason why I recommend the stretchers should be left behind will appear when I deal with the second of the three situations, viz., when the battalion is attacking the enemy.

When a force is defending a position it is advisable that lulls in the fighting should be taken advantage of, not only to remove the wounded, but also the dead from the trenches, fighting troops being made use of for this purpose if the O.C. companies will give permission. The dead are silent evidence of the extent to which the battalion has been punished by the enemy's fire, and, if possible, should be removed, as their presence is dispiriting to the men.

(*b*) With regard to the second situation, when the battalion is attacking the enemy.

R.A.M.C. "Training" states that the R.A.M.C. officer under the orders of the C.O. will endeavour to select suitable places for aid posts to which the wounded can be brought by the regimental stretcher-bearers, and from which they will be taken by the bearer sub-divisions of the field ambulances. This selection of sites for aid posts must certainly, in my opinion, be left over until the battalion is actually in action. If the enemy is holding a defensive position, his advanced screen will permit of no reconnaissance over the ground where the aid posts are likely to be wanted, and in the event of both armies advancing towards each other ready to give battle when they come in contact, no one with any degree of certainty can forecast where the battalion is likely to become engaged. I take it that if the medical officer implicitly follows the directions given in our "Training," he will, on the battalion being formed up to advance into action, keep the regimental stretcher-bearers with him until the battalion has come under effective rifle fire, when he will decide upon some convenient place for use as an aid post. He will then extend his bearers in rear of the battalion, and instruct them to render first aid to the wounded, and, if possible, bring them on the stretchers to the aid post, the position of which will be known to them. The Maltese cart, with the medical equipment in charge of the regimental orderly, will remain

at the aid post while the R.A.M.C. officer accompanied by his orderly lance-corporal will advance with the battalion, rendering first aid to such of the wounded as he meets with, and attempting to supervise the work of the regimental bearers. If he has exercised forethought and zeal, these men will be well trained in first aid, and will not make the mistake of attempting to move such cases as are better left where they fell while the action continues. This is what I understand our R.A.M.C. "Training" suggests should be done, and I should like to state with all humility that I have tried it and found that it does not work satisfactorily.

The objections to it in my experience are the following :—

When casualties are numerous, after the first few minutes, the regimental stretcher-bearers are no longer with their companies, or if working directly under the orders of the R.A.M.C. officer, are no longer with him, but are, especially if the battalion is advancing, far away in the rear carrying wounded to the aid post, and my experience has been that when they get there they seldom return to the firing line, but remain in rear, doing good work it is true, but carrying out the duties which properly belong to the bearer division of a field ambulance, and not to the regimental medical detachment. Besides the number of regimental bearers to a stretcher is only two. How many heavy men will two bearers be able to carry long distances over rough ground before they become exhausted? In the meantime, as casualties occur there is in many cases no one whose hands are free to look after them, and render the all-important first aid in the firing line with the exception of the R.A.M.C. officer and his orderly, and he, when casualties are numerous and extended over a long front, cannot, unaided, answer all the calls of "pass the word for the medical officer." In consequence, men whose duty it is to fight, and do nothing but fight, in many cases cease firing to look after their wounded comrades, and so the firing line suffers depletion to a certain extent, perhaps at the time when the struggle for fire supremacy is at its height. A soldier who in battle ceases firing without orders, to look after a wounded comrade, in my opinion, disobeys the spirit if not the letter of the regulation given in F.S. Reg., Part II, sect. 90, para. 2. This regulation is as follows :—

"In action against a civilized enemy, no one other than a stretcher-bearer is to carry a wounded man to the rear, unless ordered to do so."

Again, when the action is over, and when in certain cases help

in getting in the wounded is available from the fighting troops, there are no stretchers at hand, or obtainable, as they may be by that time miles in rear, and in consequence little can be done in the way of collecting the wounded together in some convenient place so that the work of the bearer divisions in clearing the field may be expedited. What I should be inclined to do in such a situation is as follows:—

I should, before the action, ask permission of the C.O. for a water-cart and driver to be placed under my orders, and also inform him that I intended, with his approval, to make use of the R.A.M.C. personnel. I am quite sure that nine out of ten C.O.'s would make no difficulty about this.

Then, having disposed of the arms and ammunition of the regimental stretcher-bearers, I should give them their S.B. badges but no stretchers, and also supply each man with as large a quantity of dressings as he can conveniently carry for use in cases in which the first field dressing might be inadequate. At the same time I should give them orders that during the action they are to remain with their companies and render first aid to the wounded, but beyond helping or carrying wounded men to cover near at hand, they are to make no attempt at removing the wounded. The water-cart and the Maltese cart I should keep with me until the battalion was under effective rifle fire, when I should decide on a convenient site for an aid post, and leave there the R.A.M.C. personnel, the water and Maltese carts, under the control of the corporal R.A.M.C. If really good cover is not available at the post the teams should be unhooked and sent to the rear, but they must not be sent so far away as not to be available in a reasonable time when required. The first care of the R.A.M.C. corporal should be to improve the cover available for wounded by means of the trenching tools carried in the Maltese cart, and then the men under his command should be employed in carrying any seriously wounded men near at hand to the aid post, where they should be properly dressed if this has not already been done, and laid on the ground under cover. The wounded able to walk will, soon after the post has been established, begin to make their way past it to the rear, and those requiring it should be dressed, given water, &c., and directed to the Divisional Collecting Station, if the A.D.M.S. has ordered the establishment of one. The wounded collected are to be handed over to the bearer division operating in the area, but the corporal in charge of the aid post should be warned that, except under the express order of a R.A.M.C. officer, none of his eight stretchers are to be used

for carrying the wounded to the rear, unless others are given in exchange by the bearer sub-division.

If the battalion is successful and is gaining ground and advancing, the corporal in command of the aid post is to send for the teams and advance the Maltese cart and the water-cart until he again comes into the zone of effective fire, when he should halt, establish an aid post and carry on as before. He must leave none of his scanty personnel with the wounded he may have collected at the aid posts first established, but should leave them for the bearer division to deal with, if they have not already done so. For the benefit of junior officers allow me to explain what I mean by the term effective rifle fire. Rifle fire should be considered effective when it is beginning to cause several casualties from among the troops. The mistake must not be made of fixing the site of a regimental aid post too soon because a few bullets are buzzing about, or because three or four men have been hit. One should wait until the casualties begin to become numerous, which will usually be the case when the battalion firing line is about 1,000 yards distant from that of the enemy. Artillery fire need not generally be considered with respect to the time of forming aid posts. Casualties from it should be dressed, placed under cover, if possible, and left to the care of the bearer divisions.

After having given orders relative to the position of the aid post, &c., the R.A.M.C. officer, accompanied by his regimental orderly, should then proceed to the firing line, and personally do all he can for the wounded, and exercise such control as may be possible over the regimental bearers. This should be his duty, and his position, as long as the action lasts. His place is with his battalion and not at the regimental aid post, which is properly in the zone of the labours of the bearer divisions.

When the action is over, if the battalion is not employed in the pursuit, orders should be sent for the Maltese cart with the stretchers to be brought up, and with aid from the battalion the ground over which the battalion has fought should be thoroughly searched and the seriously wounded brought to some place which is accessible for ambulance wagons. While this is being done a messenger should be sent to inform the bearer division as to the place where the wounded are being collected. A great number of wounded can be got together in one place if eight stretchers and plenty of willing bearers are at hand. In the event of the battalion being sent in pursuit of the enemy, the R.A.M.C. officer with the regimental

bearers and Maltese cart must accompany it, but I should be inclined, if the casualties have been heavy, to leave the R.A.M.C. personnel with the water-cart behind, so that they may search for and relieve the wounded. They will know the ground over which the battalion advanced, and in consequence will be able to give information to the bearer divisions as to where the wounded will be found.

(*c*) I now come to the third situation, viz., when engaged in an encounter battle. In such a situation the object of the Commander will be to deploy his men as soon as possible, and if possible to do so before the opposing Commander can succeed in deploying his. In consequence, everything will be carried out with the utmost rapidity, and the R.A.M.C. officer must make his arrangements quickly. There will be no possibility of selecting a site for an aid post beforehand, and all that he can do is to get his regimental medical detachment together, dispose of their arms and ammunition, issue to the men their S.B. badges, bandages, lint, &c., and send them to their Companies with orders to remain with them throughout the action, and render first aid to casualties as they occur.

The man in charge of the Maltese cart with the medical equipment should be ordered to remain in touch with the battalion, and when it has deployed to advance in rear of it, and when the troops have got under effective rifle fire to halt under cover, if available. The R.A.M.C. personnel should be at hand, as the water-carts are with the first line of transport. The corporal in charge should be ordered to take one water-cart and carry on as I have described in the second situation, i.e., when the battalion is engaged in the attack. It may happen, probably often, that in encounter battles no wheeled transport can accompany the battalion into action. In such an event the R.A.M.C. officer must without hesitation abandon his medical equipment cart to follow as best it can, and he himself go on with his battalion, but before doing so he should give the corporal R.A.M.C. orders to get the Maltese cart and water-cart along if he possibly can, and should leave him the four privates R.A.M.C. to give him a chance of being able to do so. Six men can get such carts over country which to all appearances is impossible, if they work hard and intelligently. The R.A.M.C. officer will probably not know where the bearer sub-divisions of the field ambulance are, and should rest content with the knowledge that, wherever they may be, they are trying to come up to the scene as quickly as possible. His concern should be that, as far as is humanly

possible, the wounded shall get first aid, and above all have the first field dressing properly applied to their injuries. They cannot be moved any distance, and beyond dressing them and relieving their pain he can do nothing more. If he succeeds in doing that much he will have deserved more than well of his country.

I shall now make a few remarks concerning the treatment of wounded on the battlefield. The most important point of all is the proper application of the first field dressing; the importance of this cannot be overestimated, and although I have referred to it at every opportunity I should like to do so again. The only treatment really required for about half the wounds received in action from the small bore conical bullet—I have no experience of those inflicted by the pointed bullet—is the skilful application of a first field dressing. If this is properly applied, the wounded soldier in the majority of cases has an aseptic wound, and a few days' treatment and rest is in very many cases all that is necessary before he can return to the ranks. If the wound, on the other hand, becomes septic, weeks or months must elapse before he is again fit for duty. Leaving out the humanitarian side of the question, consider of what enormous importance this is from the point of view of the G.O.C.! The primary object of the R.A.M.C. is to help our country to win its battles, and we can do this by keeping up the fighting strength of the Army by every means in our power. The proper application of the first field dressing is one of these. The question of relieving the pain of the wounded is considered very briefly in our "Training," and it states that an opiate should only be given under the orders of a medical officer. Personally, I see no reason why a well-trained regimental bearer before going into action should not be supplied with a small tube containing $\frac{1}{3}$ grain tabloids of morphia, with instructions to give one to each severely wounded man he attends to. The medical officer should also take care to provide himself with two or three ounce bottles of injection of morphia, and a spare hypodermic syringe in addition to that in his pocket case, and should inject serious cases such as abdominal wounds, gunshot fractures of the bones of the lower limbs, &c., with a full dose of morphia. Such treatment if intelligently carried out, abolishes much of the physical and mental agony which wounded soldiers undergo in default of this relief. It may be objected by some that there are no facilities on the battle field for sterilization of the needle. The dangers from sepsis are small, so small as to be almost negligible, and they certainly should be neglected under such circumstances. Which would any of you

officers prefer—hours of pain, or an injection of morphia followed by several hours' release from mental anxiety and physical pain, but attended by the remote possibility of an abscess forming at the point of injection? I know which of the two I should choose.

To conclude, I should like to say a few words about the brassard bearing the Geneva Cross and the Red Cross flag. The idea, I believe, still lingers that the brassard is worn so that the enemy's riflemen may see it and not fire on us while we are engaged in our duties in action. In modern war the ranges of effective rifle fire are so long that the brassard could never be noticed, and if noticed the enemy most certainly will not cease firing at that part of the line in which one of us might be at the time. It might possibly be some protection at very close ranges, but I very much doubt it. In the stress of battle a soldier cannot be expected to dwell on his aim long enough to see if his mark has a brassard on his left arm.

The Red Cross flag should also never be exhibited near the firing line; this is a wrong use of it, and the enemy will most certainly disregard it.

It must be remembered that in war neither side trusts the other, and indeed in every campaign which has ever been fought under the terms of the Geneva Convention, both belligerents have levelled accusations against each other of the abuse of this emblem.

DISCUSSION.

Colonel Skinner said: From my own experience I can endorse many of the views expressed by the lecturer, more especially the remarks he made on the sanitation of units in the field. That is a matter of primary importance because it is only occasionally that a really big fight takes place in the present day, and where one has occurred the unit is not likely to be engaged again for some time. But in order to be ready for that one big fight, sanitation is of vital importance, and on it will depend the efficiency of the unit. The only point I would like to specially mention is about leaving the ground in a sanitary condition. In India units use incinerators in the field much more than we do, and many battalions use "portable" incinerators. I personally regard them as an extremely valuable aid in standing camps, and I would like to see their value more thoroughly appreciated.

About the men trickling back from the field carrying wounded, this invariably happened in the old days. The stream of men disappearing from the firing line was considerable, and when once a man got back with a stretcher it was quite a business to get him up again.

Lieutenant-Colonel M. W. Russell: Several points of interest have

been brought out in the paper we have just heard. The first I should like to allude to is the great difficulty which confronts the regimental medical officer in deciding what cases he may keep and which he must send to the field ambulance. The regimental medical officer must keep clearly before him that his main duty is to the battalion and not to the individual. He must, by every means in his power, keep the ranks full and allow none to get back who are capable of work; at the same time he must preserve the mobility of the battalion by keeping none with it who are not fit for the work which may be on hand. If he sends men to the field ambulance who will be well in two or three days, he will get them back when that time has elapsed, unless a hurried move takes place, when he will lose a few, whom, however, he would have lost in any case; but if he keeps those men with him he may upset secret military plans and lose the men all the same. The following incident occurred more than once in South Africa: A column commander was resting near the rail. He received secret orders to march that night as part of a concerted movement, and he knew that heavy casualties might occur. He gave his field hospital detachment commander timely warning, told him that a train would be passing at dusk, and directed him to quietly get rid of his sick and be ready to march. This the latter succeeded in doing without attracting attention. You can imagine his disgust and despair when, on the order being given to the troops to march later in the evening, the O.C. field hospital found himself flooded with men unfit for the road who had been kept by the regimental medical officers, because they would be fit in two or three days. This mistake was not made by experienced medical officers; they developed an extraordinary flair for anything in the wind, and were rarely caught napping, but at that stage of the war many of the medical men with units were without military training, and allowed their professional zeal to outrun their military responsibilities. I mention this as only one of the difficulties which a regimental medical officer has to solve. His course is by no means an easy one to steer. He can only succeed by keeping always in front of him his duty to his unit, i.e., to prevent any avoidable wastage, but at the same time to keep his battalion mobile and ready for any eventuality. In time, if he is observant and studies what happens around him, he will develop that intuition of coming events which characterizes the experienced campaigner, and which will guide him better than any other form of knowledge.

I was glad to hear Major Ensor's emphatic pronouncement in favour of sending the regimental stretcher-bearers with their respective companies. The idea of massing them under the medical officer for him to distribute as he thinks occasion requires, which I have heard advocated, has always seemed to me to be unsound and impracticable. The medical officer, once casualties begin to fall, will be much too busy to do anything of the kind. If the men stick to their companies they will

be carried forward with them and will be where they are wanted, and the medical officer will know that no part of his unit will be without them.

Another very interesting point which has been raised is as to whether the stretcher-bearers should take their stretchers with them at the inception of an action. The question is one which requires very careful consideration. There is much to be said on both sides. If they do not take them with them, they may not be able to get them when they want them. On the other hand, the carrying back of wounded under heavy fire is usually impracticable; the practice was abandoned in Manchuria. It is also very undesirable for the stretcher-bearers to leave the fire zone. They can be most usefully employed as dressers. But for this their training must be improved and the quantity of dressing material with the regimental line must be increased. The correct application of the first field dressing is becoming of greater and greater importance. It means the saving of lives and the quicker return of more men to the ranks. I think most regimental surgeons would like to see each pair of his bearers equipped with a dressing bag, containing a reserve of first field dressings of various sizes, some large enough to deal with shrapnel wounds. The French have had these dressings for some years, and I hear they were found of great service recently with the Servians. With them the regimental medical officer would be much better equipped for his task, especially as wounded under modern conditions may be left much longer on his hands than was formerly the case. Given such a provision, delay in carrying back the severely wounded might be to their advantage, and the stretchers might be left behind until conditions were such as to allow of their use under more favourable circumstances.

The last point to which I will allude is the position of the regimental medical officer in an attack. Should he be with the fighting line or in the neighbourhood of the battalion supports and reserve? As you know, continental armies have two medical officers with each battalion. One goes up with the fighting line, and one is withdrawn to assist in forming the regimental dressing-station. As each continental regiment consists of three or four battalions, this regimental dressing-station would be equivalent to a brigade dressing-station. It is interesting to note that the Japanese in Manchuria, though they followed the German pattern closely in other respects, did not form regimental dressing-stations, but did as we do, formed battalion aid posts, the main dressing-station being formed by the divisional bearer battalion in rear. Nor did they find any reason throughout the protracted campaign to vary this arrangement. Their second battalion medical officer was at the aid post.

These armies with two medical officers per battalion are not in the same position as ours with only one. They attach great importance to the medical officer with the fighting line, not for the professional work he can do, which is slight, but for the effect which his presence has on

the *morale* of the troops. The fact of his being there makes the men less inclined, if wounded, to go back for assistance. But they have not got to choose between having one in front and none behind, or one behind and none in front. The point on which I wish to elicit opinion is, where would the one medical officer be of most use?

At present, a medical officer with us has no option in the matter and wants none. When the word is passed back, as it always is, he goes up. He is glad to go up because, not to mention other reasons, it is much pleasanter to have something engrossing to do when you are being shot at. I am not in the least thinking of the danger to himself, nor is he. After all, it may not be much greater than if he remains in the neighbourhood of the supports. But what I want to get at is, whether, if he goes up at the first call, he is in the best position to do what is best for his battalion. If he goes up to a flank it is because fire is telling there and he may be pinned there. A battalion may well have a front of 500 yards. The remainder of the front is without his services, wounded men getting back from the front are without his aid, casualties occur, often in large numbers, in the supports and reserve, and he is beyond their reach. We must not forget that a battalion has depth as well as breadth.

The question is by no means an easy one to decide. I have discussed it with many officers who have been wounded, and their opinion has not generally coincided with that of most medical officers. Without some specific instructions in the book the present practice will continue. Is it the best? That is the point on which I should like to hear the opinion of medical officers who have had experience with battalions in action, and who are not likely to be in the same position again.

Major E. B. Waggett, R.A.M.C. (T.): I would like to ask if we can have information about the method of distributing our bearers on the morning of an action. It seems to me that the duties of the medical officer as to the distribution of the stretcher-bearers are not very clearly defined. Should he use pivot points like entrenchments, and also would it be wise to keep the water-carts and Maltese cart with the reserves? I take it that in all probability the carts would never keep up when the reserve was advancing, but would pick it up during the fighting. I would like to know how we should distribute our bearers in these circumstances.

Surgeon-General MacNamara: The remarks of the lecturer on the sanitation of battalions were very good, but I do not think we realize sufficiently that, to a very great extent, we breed disease ourselves, especially enteric fever. I think it to be the fact that we breed our own diseases as we march, and I do not think that this point of view receives enough consideration in the Service. We sometimes put a hospital in the middle of our healthy men, and it is one of our greatest centres of infection. If there is a case of enteric fever in the hospital it will certainly breed others. The first thing we should do is to put the hospital well away from the healthy men.

Colonel HARPER: I am glad to see several Territorial Force officers here to-night, and I have to thank Major Cummins for so kindly sending me some tickets for distribution to those who are not members of this Society.

I have very few remarks to make, but as far as we Territorials are concerned, I feel sure that the most important thing we have to grasp is the question of sanitation. No opportunities to put the knowledge we possess into practice exist, and the ordinary knowledge of civil life that we get with the D.P.H. hardly applies to sanitation in the Army. I am glad the lecturer referred very fully to this particular subject. I feel that it is one of the most important parts of the paper. I would like to see this paper issued as a pamphlet by itself, and if it is not too expensive I would like to take fifty copies to distribute amongst the medical officers of my division, as it will give them much fuller information than anything we can gain from the manuals.

May I ask when the medical companion is exhausted how is it replenished and from where?

With regard to the medical examination of reservists, although this does not affect the Territorial Force, I understand that a preliminary examination is carried out in the regular Army. By whom is it done? How are all the men examined by a medical officer who is attached to them only on mobilization? In each Territorial unit, of course, every man would be required to be examined on mobilization.

Lieutenant-Colonel COTTELL: I should like to mention that a most excellent paper was recently read at the Royal United Service Institution by the War Correspondent of the *Morning Post* with the Bulgarian Army. He particularly mentioned the failure of the medical arrangements of the Bulgarians. In that war, wonderful as it has been, the officers commanding regiments were frequently held back by the incubus of their wounded. The medical arrangements for evacuation of the sick and wounded simply did not exist.

Lieutenant-Colonel C. H. BURTCHAELL said: He would like to refer to a few points mentioned by Major Ensor in his valuable paper. In discussing that portion of R.A.M.C. "Training" relating to aid posts, Major Ensor gave his opinion as to the meaning of a certain paragraph, but he evidently omitted to take into consideration the paragraph immediately preceding. When, applied to a particular situation, Major Ensor considered the principles in the training manual were impracticable and could not be carried out. In the situation suggested his scheme would work admirably, but in many other situations it might not suit at all. It was absolutely impossible to provide in detail for all tactical situations in the text-books. The whole of the work of the regimental medical service in action is contained in these very few points: (1) To render first aid. (2) To remove wounded to cover, and if they cannot be brought to an aid post to endeavour to group them. (3) If unable to move the wounded

collectively, to do so individually. (4) The medical officer, if possible, to select sites for aid posts, which, if established, should be under cover and as near the fighting line as possible. Those principles can be applied to any situation, and it is impossible to lay down a hard and fast rule.

Regimental stretcher-bearers should be trained in first aid to the highest possible extent, and our system of supply of dressings should be revised to enable these men to carry more dressings, the supply of which in the regimental establishments is not at present adequate. The importance of ensuring that the regimental stretcher-bearers are really efficient is often not realized. Recently, however, more attention has been paid to their training in first aid.

As to men getting away from the firing line to assist wounded, the medical officer can do little to prevent them doing so—it is dependent on regimental discipline and the circumstances of the fight.

As regards the position of the regimental medical officer, he should be in the firing line. He may not be able to do very much up there but the effect on the *morale* of the men is considerable, and if he is at an aid post in rear, does that not in itself create a tendency for men to come back with wounded comrades and remain there? The solution is to have two medical officers with each battalion, as is the case in other armies, and it might be even sound to move one of the officers now allotted to a field ambulance up to the regimental medical establishments.

Whether the R.A.M.C. personnel for water duties will be available to assist at the aid-posts during an action depends more or less on the position of the water-carts, which may not get near the firing line. When a deployment is in progress they may be left far behind, but by all means use these men if you can get the carts up.

Every R.A.M.C. officer who has been in front during a fight will realize the extreme importance of giving morphia. The question is how to carry it and how to administer it. A hypodermic syringe is unsatisfactory. Powders which can be dropped into a man's mouth are most effective. They are better than tabloids because the morphia dissolves quicker. It is important to realize that badly wounded men require at least half a grain to start with, and this entails no greater danger than giving a smaller quantity. Of course, if we are going to engage in one of those great battles, so often spoken of, there will be an enormous number of wounded, and it will be impossible for the medical officer to give morphia to every man who needs it, consequently the subordinate medical personnel should be instructed in the methods of its administration.

Major Ensor, in reply, said: All these questions are so highly controversial that I hesitate about saying much in reply. Colonel Russell asked as to the relative importance of the medical officer in the firing

line or at the aid posts. Personally, I agree with Colonel Burtchaell. I think he should be in the firing line. When the wounded begin to call for the medical officer, he must go to them. The range of effective fire nowadays is perhaps 1,000 yards, and most men are hit by shots fired at a venture. I do not consider that a medical officer incurs an excessive amount of danger in carrying out his duties in the firing line.

With regard to the replenishment of the medical companion, when the medical companion is exhausted, the medical officer indents upon the field ambulance for fresh supplies.

As to who carries out the preliminary medical examination of reservists, this is carried out at the place of joining of those reservists. A scheme for this is always prepared in peace time. Schemes are also prepared for the examination of the serving soldiers and are included in the local mobilization scheme.

The morphia I would give is the injection of the British Pharmacopœia. I would not attempt to dissolve tabloids in action.

As regards aid posts, I only attempted to describe them and say what I would do in such circumstances. I could not, of course, take every position. I only described what my action would be in the most common situation.

Clinical and other Notes.

A CASE OF LYMPHOSARCOMA TREATED WITH COLEY'S FLUID.

By Major C. G. Spencer.
Royal Army Medical Corps.

Corporal M. M., aged 25, was first seen by me in February, 1912. A swelling in the left side of the neck had been noticed by the patient a year previously, since when it had slowly enlarged. On admission there was a soft, rounded, freely movable tumour beneath the left sterno-mastoid. This was excised on March 6, 1912, and sent to the Royal Army Medical College for examination. Recurrence took place very rapidly, the left side of the neck becoming filled with masses of enlarged glands. The pathological report was that the tumour was a lymphosarcoma. On March 29 an attempt was made to clear out the posterior triangle on the left side, but removal of the growth was incomplete. The wound healed well, but again recurrence took place very quickly.

Treatment with Coley's Fluid was commenced on April 6, Parke, Davis and Co's preparation being used. The initial dose was ½ minim, and this was gradually increased for three weeks, an injection being given almost every day. By April 26 the amount given daily was 10 minims, and this amount was continued until May 11.

A well-marked reaction with a good deal of local inflammation followed each injection. Except for the first few days, all injections were made into the tumour itself. After the first week of the treatment no further increase in the size of the growth could be made out, and decrease in its size soon became apparent, though this was masked to some extent by the local inflammation and thickening set up by the injections. After the injections were suspended on May 11, the inflammatory swelling subsided, and in a few days nothing could be felt of the tumour. A further course of injections was given from May 29 to June 29, 10 minims being giving on alternate days. The patient was kept under observation for two months, and then returned to duty. When last seen, in March 1913, there was no sign of any further recurrence, and, except for the fact that at the second operation the spinal accessory nerve was injured, causing some weakness of the shoulder, he appears to be in perfect health.

Summary of Treatment.—Initial doses, ½ to 9 minims, April 6 to 25, 16 injections; total 76 minims. Full doses, 10 minims, April 26 to May 11, 14 injections; total, 140 minims. Second course of injections, 10 minims, May 29 to June 29, 15 injections; total, 150 minims.

A CASE OF AMŒBIC ABSCESS OF THE LIVER WHICH HAD BURST INTO THE LUNG, CURED BY EMETINE HYDROCHLORIDE.

By Major E. P. SEWELL.
Royal Army Medical Corps.

The following notes may be of interest to officers of the Corps, as illustrating the efficacy of emetine in the treatment of amœbic diseases, even in cases where all other treatment has failed. In the case recorded here scarcely any hope of the patient's recovery remained, and the rapidity and completeness of the cure which followed the injection of emetine hydrochloride was simply astonishing.

Gunner W. J. R. was transferred to the Military Hospital, Colombo, from H.M. Transport "Somali," on October 4, 1911, diagnosed "ague." He had been stationed at Khartoum, where he had enjoyed good health. He had never previously had an attack of ague, nor in fact fever of any kind. He had no knowledge of ever having had dysentery. After thirteen days in hospital he was transferred to the convalescent depot at Nuwara Eliya, where he remained for a fortnight without any symptoms, and returned to Colombo in good health. On January 2, 1912, he was re-admitted to hospital suffering from pyrexia. His blood was examined for malarial parasites, with a negative result, but after treatment with quinine, his temperature became normal in a few days and on January 16, he left hospital apparently well. A week later he was re-admitted with a recurrence of the fever, which again appeared to subside under quinine.

On February 1 he was transferred to the convalescent depot at Nuwara Eliya. His weight was then 10 st. 4½ lb. His temperature was normal, but he was looking pale and somewhat sallow. He was also complaining of pain in his right shoulder. His blood again showed no malarial parasites. The records of the next few months show periods of irregular pyrexia, followed by long periods of weeks at a time when the temperature remained normal or subnormal. He improved so much that he was discharged on May 3, but was re-admitted again on May 17, with a return of the pain in his right shoulder, which now became the most prominent symptom. No signs of hepatic enlargement were detected at this time, and blood counts showed no increase of the leucocytes or change in their proportionate numbers.

On May 22, and again on June 7, he coughed up blood-stained sputum, and from that time onwards he continued to cough up muco-purulent sputum mixed with blood in increasing quantities. He grew gradually worse, with continued pyrexia, and progressive loss of weight until, on July 30, on which date I took over charge of the case, his condition was as follows: He looked extremely ill, weight 8 st. 4 lb. His temperature varied from 98·4° to 102° F., the evening record having been above normal

for the last month. He had a distressing cough of a spasmodic type, and coughed up large quantities (5 to 10 oz. daily) of a reddish evil-smelling sputum resembling the pus from a liver abscess. This sputum under the microscope was seen to consist of altered blood and liver cells. No tubercle bacilli were present, and no amœbæ were detected. The liver dulness was continued upwards into the axilla, and there was marked tenderness in the intercostal spaces. Coarse râles were heard over the base of the right lung. It was evident that a liver abscess had burst into the lung, and that there remained a collection of pus in the abscess cavity in the upper part of the right lobe of the liver. On August 4, I passed a trochar and cannula into the liver at the dullest spot and, finding pus, removed a portion of rib, opened and drained the abscess. After the operation the patient's condition improved at first. He looked and felt much better, and the sputum was reduced to 1 or 2 oz. However, the discharge from the tube was not as free as one could have wished, although it was evident that the tube was actually in the abscess cavity, as a solution of quinine injected through the tube was soon tasted in the mouth. The discharge from the tube gradually dried up, while the quantity of sputum increased again until it amounted to 20 oz. a day. The patient fell back into his old condition, and it was evident that the operation had failed to cure the abscess.

On September 3, I performed a second operation. Finding pus at a deeper level and higher up than before, I resected a portion of the rib above the one resected at the previous operation and inserted a large tube into an abscess cavity which lay at a deep level close under the diaphragm.

Again there was some improvement, which was not maintained, although there was a free discharge from the tube. The patient relapsed into his old condition. The cough became more and more distressing, as much as 20 oz. of sputum being coughed up daily. Pyrexia was constant, and his weight fell to 7 st. 12 lb. He gradually lost heart, refused his food, and generally appeared to be sinking rapidly. I had little hope of his ever reaching England alive. From September 19 to 29, he was given 20 gr. ipecacuanha daily without the least effect.

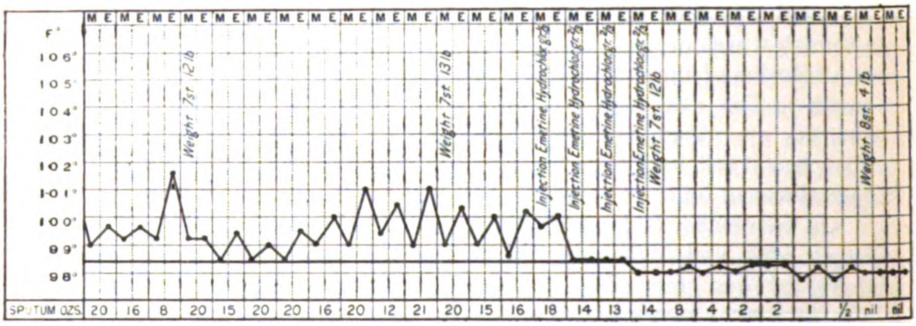
On reading the article by Major Leonard Rogers, I.M.S., on the curative action of emetine salts on amœbic diseases (*Brit. Med. Journ.*, August 21, 1912), I determined to try his treatment, and, fortunately being able to procure some emetine hydrochloride, I gave the man an initial dose of $\frac{1}{3}$ gr. hypodermically, on October 15. Next morning his temperature was normal, and, after a second dose of $\frac{2}{3}$ gr., his evening temperature was also normal, for the first time for over three weeks, and remained normal during the rest of the time he was in hospital. On the next two days he received two doses of emetine hydrochloride ($\frac{2}{3}$ gr. each day), making four doses, amounting to $2\frac{1}{3}$ gr. in all.

After the treatment the patient's general health improved rapidly. He

regained his appetite, slept well, and felt a new man. His cough improved at once, and the sputum gradually diminished in quantity, until, on October 25, eleven days after the commencement of the treatment, the cough and expectoration ceased altogether.

The discharge from the tube, which was very free before emetine was given, also decreased rapidly, and the tube was finally removed on October 23.

After this the only difficulty was in supplying him with as much food as he wanted, and he left for England on board the Transport "Rohilla," on November 30, in the best of health, and weighing 9 st. 13 lb., having gained 2 st. 1 lb. in six weeks. A temperature chart covering the critical period of his illness is attached.



I have also employed the emetine treatment on several cases of chronic dysentery, and in each case the cure was immediate and permanent.

I tried the treatment in one case of acute dysentery in the stools of which the *Entamœba histolytica* could not be detected. The drug had no effect whatever on this case, but it yielded rapidly to treatment with salines.

Since writing the above, I have received a letter from Gunner W. J. R., dated January 21, 1913, in which he says that he has kept well since leaving Colombo, and is "coming on nicely."

I am indebted to Lieutenant-Colonel M. L. Hearn, R.A.M.C., for permission to publish this case.

THE TREATMENT OF DIFFUSE SEPTIC PERITONITIS DUE TO APPENDICITIS, ILLUSTRATED BY FOUR RECENT CASES.

By Major G. F. STONEY ARCHER.
Royal Army Medical Corps.

Thanks largely to the teaching of Murphy and Fowler the mortality of these cases is not so great as it was a few years ago, but it is still very high. I noticed last year in one of our journals, that out of five cases operated on in one of our big military hospitals, there were three deaths, a death-rate of 60 per cent.

Four cases have recently been under my care; they all had diffuse septic peritonitis, and, on opening the abdomen, there was an immediate spurt of fluid, under tension, not from a localized abscess but from a general diffusion in the general peritoneal cavity.

Case 1.—I was asked to see the patient late one evening. He was in a collapsed condition, face anxious and drawn, abdomen rigid, especially on the right side, where it was acutely tender on palpation; there was no movement with respiration, pulse 120, temperature 102° F., respirations 20, the bowels were not open.

He stated that he had been suddenly seized with violent pain the night before, and since that time had been vomiting frequently. As he had only just been brought into hospital and was in such a collapsed condition, I postponed operation till the following morning. He passed a bad night, and, except that he did not appear to be so collapsed, his general condition was unchanged next morning.

Operation.—An incision was made through the outer edge of the right rectus sheath; as soon as the peritoneum was opened thin, very foul-smelling fluid gushed out. The appendix was found to be gangrenous and perforated in its distal portion; there were no limiting adhesions, and the general peritoneal cavity was intensely inflamed. The appendix was ligatured and removed, the stump being inverted with a purse-string suture. The various steps of the operation were carried out quickly, the bowel being handled as gently and as little as possible. No attempt was made to either irrigate or swab out the peritoneal cavity or pelvis. In these cases there is not the slightest necessity to do so, there are no adhesions, and the fluid flows in the line of least resistance, namely towards the wound. Irrigation would only disseminate still further the infection, and swabbing simply removes layers of protective lymph and produces bare patches through which the toxins can more readily enter into the general blood-stream.

The appendix having been removed, glass drainage tubes leading down to the bottom of the pelvis were placed in the lower angle of the wound, the upper portion of which was closed in layers with iodized-formalin catgut.

Throughout the operation the patient's thorax was kept raised at a higher level than the abdomen, and he was removed to bed in this position, and placed at once half sitting up, as recommended by Fowler. Immediate proctoclysis was commenced with 1 oz. of sugar added to each pint of the normal saline solution, the sugar being added in the hope that some of it would be absorbed and help to keep up the patient's strength. As soon as the influence of the anæsthetic had passed off, he was encouraged to drink cold water, and was given a powder every third hour containing ½ gr. of calomel, and 3 gr. each of salol and bicarbonate of soda. By the following morning he had absorbed 7 pints of the saline per rectum; the wound was discharging freely, and the improvement in his general condition was most marked, his face having entirely lost the anxious and drawn expression of the previous day; temperature, 98·6° F., pulse 74, respirations 18. His bowels acted on the third day, and from that on his progress was satisfactory and uneventful, with the exception that he developed a somewhat troublesome cough, but this soon passed off, and he was up and about with his wound soundly healed about five weeks after the operation.

Case 2.—The patient stated that he had been feeling ill for four days, but had not reported sick as he thought the symptoms would wear off. He complained of the usual pain on the right side of the abdomen; the right rectus was rigid and acutely tender; temperature 101·6° F., pulse 90, respirations 28, bowels not open.

It was decided to operate at once. The peritoneum was found to be full of foul-smelling fluid, and the appendix was gangrenous and perforated. It was removed, and the further treatment carried out on the same lines as the previous case; he never looked back, and was discharged from hospital, quite recovered, five weeks from the date of admission.

Case 3.—The general condition and abdominal symptoms were similar to the last case; temperature 100·6° F., pulse 104, respirations 28. On opening the abdomen there was again a quantity of dark-coloured fluid containing flakes of lymph, but it was not as foul-smelling as in the other cases. The appendix, though intensely inflamed, was not gangrenous, nor could I find any perforation; it was removed with some difficulty, as it was bound down with numerous old adhesions. His treatment was similar to the other cases. The bowels acted on the second day after operation, and his further progress was quite satisfactory for a fortnight, when his temperature commenced to go up, especially at night, and he subsequently developed a right-sided empyema. This was drained, a portion of the eighth rib in the posterior axillary line being removed for the purpose. His abdominal wound healed rapidly, and he is now quite well.

Case 4.—This patient was admitted at six o'clock in the evening in a very collapsed condition, and suffering from very acute pain. He stated that he had been ill for two days, but that the intense pain had

only come on a few hours previously. Pulse 100, respirations 26, temperature 97·8° F. The abdomen was distended, and very tense. He was operated on at 8 p.m. that night; the abdomen was full of foul-smelling purulent fluid, which gushed out as soon as the peritoneum was incised. The appendix was rather tightly bound down with old adhesions, its tip was gangrenous and perforated. He was treated in the same manner as the other cases, but his condition did not improve so rapidly after the operation; for a week he was in a critical condition owing to intense toxæmia, with paralysis and distension of the intestines, and frequent vomiting; his temperature was continuously below normal. He was treated by washing out the stomach twice a day with an alkaline solution, and was given pituitary extract intramuscularly. Saline proctoclysis was kept up almost continuously for a week.

Four days after the operation his bowels acted, and since then his progress has been steady and satisfactory. He is now quite well.

In conclusion, I should like to emphasize some points, which I think are important in treating cases such as the above :—

Operate as soon as possible, and with as little disturbance of the inflamed intestines as possible; their vitality is already lowered, and any pulling about will increase the shock from which the patient is already suffering, and will also tend to cause paralysis of the intestines themselves. Do not irrigate or swab out the peritoneal cavity, it will do more harm than good.

Remove the appendix, which is the source of the trouble.

Use glass drainage tubes, they do not adhere to the intestines in the way that rubber tubes do, they do not become blocked so easily and are easily removed and easily replaced. Gauze for abdominal drainage is an abomination and should, I think, never be used, it sticks to everything and blocks the wound instead of draining it. Use iodized-formalin catgut for sewing up the wound; in these septic cases silk or linen is liable to cause subsequent trouble, and plain catgut becomes absorbed too soon. Keep the patient's thorax raised during the operation, and nurse him in Fowler's semi-sitting position. Commence proctoclysis at once and continue it till the patient is able to drink freely without vomiting; he should be given water and encouraged to drink it from the time he comes to from the anæsthetic. I put all my appendix cases on ½ gr. doses of calomel with a few grains of salol every third hour till 5 gr. of calomel have been taken, or till the bowels have moved; it tends to prevent putrefaction in the intestines with flatulence, stasis and distension, which are very serious complications when they occur. I have not gone into the treatment of these cases by vaccines and antitoxic serums, as owing to being abroad till recently I have no personal experience of their value, but I think that material for an autogenous vaccine ought to be obtained at the operation; it will then be ready, if required, at a later date.

PREGNANCY COMPLICATED BY EPILEPTIC FITS, BURNS, AND THE STATUS EPILEPTICUS. CÆSAREAN SECTION. RECOVERY.

By Captain S. E. LEWIS.
Royal Army Medical Corps.

Mrs. McL., aged 30, was admitted to the Military Families Hospital, Devonport, on January 22, suffering from severe burns of the 4th degree, on the right arm and both breasts, as well as burns of the 2nd degree on both sides of the face, right and left forearm.

The patient was well known to me as an epileptic, and the burns were the result of having fallen on the fire during a fit. On admission she was in great agony, but by no means collapsed. Pulse regular, 76; temperature 98·4° F.

Further examination showed that she was just over eight months pregnant, the presentation being an L.O.A.

The urine was also at once examined: reaction acid, specific gravity 1018, and free from albumin and sugar.

Auscultation of the fœtal heart revealed that the child was alive and in no distress.

Treatment.—The patient was put to bed, all blisters were opened, as much charred tissue as possible removed and the burns were dressed with a solution of picric acid; $\frac{1}{3}$ gr. of morphia was injected, and she was ordered a mixture of pot. brom. 15 gr., and chloral 10 gr.

January 25.—Although the bromide had been increased, the patient has had, on an average, seven fits a day since admission, and is very noisy but quite conscious in the intervals between the fits. She takes nourishment well and states that the pain is much less, but she is now suffering from a purulent vaginal discharge, and for this a douche (tinct. iodine 1 dr. to the pint) has been ordered.

All the burns look healthy and are healing, especially the less severe ones. The bowels have been well opened. Temperature 98° F, pulse 100. She sleeps fairly well.

January 26.—During the night there were several severe fits, and she is to-day in a condition of status epilepticus, being quite unconscious; urine and fæces are passed involuntarily, the pulse varies between 110 and 140, respirations 24, temperature 99·6° F. She is, however, able to swallow liquid food without difficulty.

The vaginal discharge is less, and the child is alive, but its heart sounds are fainter and more rapid.

January 28.—The patient is obviously worse to-day. Pulse weak, 150, respiration 28, temperature 100·6° F., and she is still unconscious. The vaginal discharge has ceased, and in the hope of starting labour, the patient was given chloroform and the vagina plugged. This attempt to induce labour was made, as most authorities agree that a patient in

this condition may improve after labour, and the fœtus was showing signs of distress. The bromide and chloral mixture has been stopped, and she has been ordered brandy, 4 oz. a day. Two injections of strychnine (3 minims) have been necessary.

January 29.—The vaginal plug was removed to-day, but the cervix is still closed. The patient's condition is unchanged.

Cæsarean section was decided upon, as this seemed to be the only chance of saving mother and child. Instrumental dilation of the cervix and delivery by forceps would be a longer operation than Cæsarean section and very liable to be followed by septicæmia in view of the recent vaginal discharge, although possibly there will be more shock after the latter operation.

At 11.30 a.m. to-day I performed Cæsarean section, assisted by Mr. Roberts, F.R.C.S., chloroform being administered by Major Collingwood, R.A.M.C.; a living female child, somewhat asphyxiated, was removed.

It was not considered advisable to perform hysterectomy on account of the patient's condition, although there was some risk of septicæmia. The patient stood the operation well and the hæmorrhage was not excessive. The child weighed 7 lb. at birth.

January 31.—The patient is now conscious, temperature 98·2° F., pulse 100, respiration 24.

All burns, except those on the breast and right arm, have healed. She, however, suffered great pain from the burns and said that the pain caused by the abdominal wound was also very acute. For this reason morphia was freely administered. She took nourishment well and had not had any more fits since the operation.

Urine and fæces are still passed involuntarily, necessitating the frequent changing of the abdominal dressing. The child is progressing favourably.

February 4.—The patient has made a steady improvement, but unfortunately there is a purulent discharge from the lower third of the wound, due no doubt to the frequent soiling of the dressings. Temperature is, however, normal, pulse 112.

February 6.—All stitches were removed yesterday, the upper two-thirds of the wound had healed soundly, but the lower part was discharging freely. Temperature 100° F., pulse 98. The burns on the breasts are slowly healing.

February 10.—Steady improvement has continued, and the discharge from the abdominal wound has almost ceased, but she has been suffering from diarrhœa for the past two days, and at times the motions were slightly blood-stained. Ordered sodii sulph. 1 dr. to the ounce, every two hours during the day.

The patient asked for her baby yesterday, and she was allowed to have it for a few minutes.

February 15.—The abdominal wound has now almost healed, and the

diarrhœa has stopped. There have been no more fits. Pot. brom. 15 gr., morning and evening was again ordered.

February 21.—The patient is now on solid food, and is allowed to sit up a little. The burns on the right arm and right breast are slowly healing.

March 3.—The patient was allowed up for half an hour to-day. She was very weak and glad to get back to bed again.

There have been a few fits since the last note. The burns on the breasts have almost healed.

March 22.—A gradual improvement has taken place. The patient was discharged to-day, all burns having healed. The baby is, however, to be kept in hospital a little longer, as she has had a moderately severe attack of diarrhœa and has not quite recovered.

Remarks.—When one considers how close the patient was to death for several days, and the great risk there was of septicæmia, the case is somewhat remarkable.

I am quite convinced that had Cæsarean section been delayed longer she must have died; the rapid change from a profound condition of status epilepticus to consciousness was very marked.

I have to thank Mr. Roberts for his assistance, and Major Collingwood for administering chloroform.

Echoes from the Past.

THE FIRST MADRAS ARMY LIST.

By Colonel R. H. FIRTH.

A recent inspection of what is held to be the first Madras Army List has suggested an article which should not be without interest to readers of our Journal. The list bears the date of 1781-2 and is in manuscript. The writing is wonderfully good and quite legible. The arrangement is simple, and merely gives nominal rolls of persons borne on the military establishment of the Honourable East India Company in Madras. The names are grouped under the various branches of the service, such as cavalry, artillery, infantry, engineers, and invalid battalion. The medical establishment is given under the heading of "medical servants." In this list we find the names of the following medical officers :—

James Anderson.	William Gordon.	Charles Ogilvie.
Colly Lyon Lucas.	John Briggs.	James Kincaid.
William Duffin.	Jeremiah Adderton.	John Walker.
Gilbert Pasley.	Job Bulman.	Henry Harris.
James Leslie.	James Richardson.	George Bell.
Thomas Davies.	Alex. Watson.	Alex. Sevenwright.
William Raine.	William Ruddiman.	John Laird.
George Binney.	George Oglevy.	Andrew Berry.
Nicol Mein.	Alex. Anderson.	George Leper.
Finlay Ferguson.	George Anderson.	Michael Corbet.
Alex. Farrier.	Henry Miller.	Thomas Brae.
Terence Gahagan.	Maxwell Thompson.	George Baird.
James Whyte.	Thomas Lord.	John Campbell.
Robert Turing.	Edward Stuard.	Fowke Moore.
William Roxburgh.	Patrick Bowie.	Bernard McMahon.
Robert Rollo.	Robert Trotter.	

The list gives no information as to the grading of these men or as to their location. There is, moreover, inherent evidence that the roll has not been written with exact regard as to seniority. It has been an amusement to me to trace out, as far as one could, the history of these men. In some cases one has been fairly successful, while in many others one has been able to learn nothing. The following details concerning some of these officers may be found interesting.

James Anderson appears to have entered the Company's service as a hospital mate in 1758, and he soon saw service at the siege of Manilla. In 1771 he came from Vellore to Madras as Presidency Surgeon and remained there till his death. In April, 1786, he was made Physician-General in succession to Mr. Briggs. Anderson is said to have been of Swedish origin; he was an ardent advocate of vaccination and a good botanist. He introduced the cultivation of silk into Madras, and paid attention to other plants of commercial value such as sugar cane, the coffee plant, the cotton plant, and the apple. He published a series of letters upon these topics in 1781, 1789, and 1796. He died August 6, 1809. A monument by Chantrey to his memory exists in St. George's Cathedral, Madras, and his grave is in St. Mary's Cemetery. On the four corners of the dome which surmounts the grave the word Anderson appears in English, Tamil, Telegu, and Hindustani; the grave has recorded on it the following epitaph: "Memoriæ sacrum Jacobi Anderson, M.D., viri optimi clarissimi, et medici supremi in hac ora Coromandelensi; ubi artem salutiferam per annos fere quinquaginta,

tantamque erga omnes benevolentiam exercuit, ut cui maxime semper in deliciis fuerit communem promovere utilitatem, et quam plurimis prodesse, sui proprii commodi omnino immemori. Obiit VI Augusti MDCCCIX anno ætat LXXII. Placide quiescas venerande vir, tuis, desiderate, omnibus flebilis, et dulce dum vixisti humanitatis decus; qui raris ingenii dotibus animique benignitate rariore ardente pura et prorsus mirabili in eo per diuturnum vitæ cursum occupatus es ut generis humani commodo consuleres non tibi sed toti mundo te genitum credens. O moribus simplex candide suavissime, ullane dies unquam te nostris eximit animis; heu quando tibi invenimus parem. Siqua vita defunctos mortalis tangunt benigne tuos respicias et infirmo ignoscas desiderio quod tui charæ imagini inexpletum immoratur. In vunculi optimi gratam memoriam, inque hororem vitæ quæ benevolentiæ et beneficentiæ dedita erat et cuius cursum mira quadam admiratione per annos vigintiquatuor contemplatus est, ædificiam hoc, ubi ossa conduntur, reverentiæ simul et mæroris testimonium propriis sumptibus erigendum curavit Andreas Berry, M.D."

The same cemetery contains also the grave of a Mrs. Young, a daughter of the above James Anderson, and widow of C. W. Young, a free merchant of Palamcottah. In the Mors Janua Vitæ Cemetery at Vizagapatam there is also a grave of Thomas Anderson, an assistant revenue surveyor and son of James Anderson. This man died February 4, 1829.

Colly Lyon Lucas joined the Company's service in 1759. He became a chief surgeon in March, 1786, was a member of the Medical Board and died March 23, 1797, aged 66. He was a well-known Freemason and married a Miss Martha Lee in 1776. His grave is in St. Mary's Cemetery, Madras.

Of William Duffin, the only traceable facts are that he was an assistant surgeon of date March 1, 1771, and was made a head surgeon on April 30, 1788.

Gilbert Pasley seems to have come out to India in 1756. He died September 23, 1781, at the age of 48. He is buried in St. Mary's Cemetery, Madras, and on the grave is this curious inscription: "This stone will not want power to melt or virtue to amend the heart. It marks the grave of the common friend of mankind. It records the memory of the skilful physician, Gilbert Pasley, and his only daughter, Susan Hannah." Pasley married Miss Hannah Dashwood. His sister Margaret married George Malcolm, and three of her sons were honoured on one and the same occasion with the K.C.B. They were Sir John (General, 1769-1833),

Sir Pulteney (an Admiral, 1768-1838), and Sir Charles (also an Admiral, 1782-1851). Pasley's widow married T. E. Ogilvie, of the Civil Service, in 1782.

One can learn little about James Leslie. His grave is in the new burial ground at Palamcottah, where he died January 27, 1785. The inscription on it is simply to this effect: " James Leslie, Esqr., formerly surgeon to this garrison, who lived esteemed and died regretted."

Thomas Davies appears to have been a head surgeon of date April 14, 1786. He died at Madras some two years later. One has failed to find his grave.

William Raine and George Binney have left no record. The most that one knows ab them is that Raine was a hospital surgeon on January 1, 1765, and head surgeon in 1788. Binney was an assistant surgeon, October 1, 1773, and a head surgeon, February 16, 1788.

Nicol Mein is traceable as a head surgeon from February 16, 1788. He became third member of the Medical Board in 1796, and died at Madras, April 14, 1804. His grave is in St. Mary's Cemetery, also that of his widow, who died June 10, 1818.

Terence Gahagan is shown as an assistant surgeon of October 1, 1777, as a head surgeon from February 16, 1788, and as Physician-General and first member of the Medical Board from September 9, 1809. He died in Portman Square, London, on January 21, 1814. He was a prominent Freemason and initiated into Masonry Omdat ul Omrah afterwards Nabob of the Carnatic. Gahagan's son became a judge, and is buried at Chittoor, while his granddaughter married in 1833 the grandson of the first Lord Harris.

Concerning James Whyte the only information available is that he was appointed a hospital surgeon on March 1, 1771, and that he resigned the service on February 16, 1788. Similar dates are given as to Robert Turing, he having resigned at the same time as Whyte. There is a grave of one Robert Turing in the Cemetery of St. Mary at Madras showing his death on June 5, 1801, aged 41. The inscription on the tomb states that " he served his country and the Honourable Company for twenty-five years in the most distinguished manner, during which period he was present with the Coast Army in every battle and siege of importance." Turing was apparently a son of Sir John Turing, Bart., and the grave of a brother of his named John Turing is at Vizagapatam. Another Turing was severely wounded in Baillie's defeat by Hyder Ali in 1780 and was subsequently killed in action.

William Roxburgh was gazetted as hospital surgeon, May 28, 1780. He was a distinguished botanist and subsequently was transferred to the Bengal establishment. He did much to develop the Botanical Gardens in Calcutta, and in those gardens there is a stone pillar to his memory having on it the following beautiful inscription written by Bishop Heber: "Quisquis ades, si locus suavitate mentem permulcet aut pie sentias de deo, habendus in honore tui Roxburghius, horum hortorum olim præfectus, vir scientiæ botanices laude florens idemque amœnitatum agrestium summus artifex; conservat cinerem patria, hic viget ingenium; tu fave et perfruere. Posuere superstites amici MDCCCXXII." There is a grave in St. Mary's Cemetery at Madras of an infant son of Roxburgh. It bears the date September 27, 1781.

Robert Rollo appears to have been appointed a head surgeon on November 28, 1780. He died at Cuddalore, where in the graveyard of Christ Church in the Old Town is a tomb having the following inscription: "Here lies the body of Robert Rollo, Esqr., Surgeon to the Residency of Cuddalore, who departed this life on the 3rd day of March, 1793, in the 34th year of his age." He seems to have married Catherine Paulina Gibson, on October 1, 1789. She subsequently married James Lennon, an engineer, on April 21, 1794.

About William Gordon, the only fact traceable is his grave, which is in the Cemetery of St. Mary, Madras. On it is the following: "William Gordon, Esqr., an Head Surgeon on this establishment, died Septr. 4th, 1793, aged 55 years."

John Briggs was appointed an assistant surgeon under the Honourable Company on November 28, 1780. He was made a head surgeon, September 12, 1793. He subsequently rose to be Physician-General, and died in 1830. He was born in 1758, and the son of Mr. Briggs, who was appointed first Surgeon-General on the Madras establishment in 1760. The John Briggs of this list married as his first wife a Miss Pybus, daughter of a member of Council, and she was the widow of Major Arthur Lysaght, brother of the first Lord de Lisle. She died in 1788, and her grave is to be seen in the old cemetery at Vizagapatam where Briggs was surgeon for some years. His first wife's sister married in 1800 the famous Sydney Smith, Canon of St. Paul's, whose brother was father of Lord Lyveden. As his second wife, John Briggs married Miss Honor Dodson, of Colombo, whose sister married John de Morgan, and their son was John de Morgan, the famous mathematician. It is curious to note also that John Dodson,

the father of Mrs. Briggs and Mrs. de Morgan, was himself a F.R.S., and author of a mathematical work on the "Antilogarithmic Canon." By his two wives, Briggs had eleven children. The eldest of all became Major-General Briggs, F.R.S., and is known as the author of a translation of the Farishta and the Seir-ul-Mutakharin. This General Briggs married, curiously enough, in 1811 Jane, the youngest daughter of John Dodson, that is, he married his stepmother's sister. The interrelationship of some of these people is very interesting, as is further shown by the fact that John Briggs's own brother, Stephen Briggs, was also in the Company's service as a surgeon at one time, and Stephen's wife was Magdalene Pasley, sister of Gilbert Pasley, who has been mentioned already, and whose other sister, Margaret, was the mother of the famous General Sir John Malcolm, of Admiral Sir Pulteney Malcolm, and of Admiral Sir Charles Malcolm. Truly some of the men of those days on the Madras coast belonged to a family party.

As to Jeremiah Adderton, beyond that he was appointed as assistant surgeon on November 28, 1780, and head surgeon on September 12, 1793, one can find no record.

Job Bulman is noted as having been appointed as assistant surgeon on the establishment on November 28, 1780. He came from Cox Lodge, Northumberland, and married, July 30, 1783, Miss Sophia Pelling, daughter of Thomas Pelling, a merchant of Vepery. The graves of Thomas Pelling and his wife are to be seen in the Churchyard of St. Matthias at Vepery. Job Bulman's wife died, March 22, 1788, aged 24, and is described on her tombstone in St. Mary's Cemetery, Madras, as "an amiable woman and the best of wives." Their son, Captain Thomas Bulman, of the 6th Madras Infantry, was killed in action, December 22, 1823, aged 39.

There is nothing traceable about James Richardson and Alexander Watson beyond that they were made hospital surgeons on July 7, 1781, and that Watson rose to be Physician-General and first member of the Medical Board in 1813. In the same way William Ruddiman was gazetted to be assistant surgeon, February 3, 1780, and hospital surgeon, April 30, 1784. George Oglevy has the same junior date, but did not become a hospital surgeon till August 31, 1785. The two Andersons have the same dates as Oglevy. One cannot trace them further.

Henry Miller, Maxwell Thompson, Thomas Lord, Edward Stuard, and Patrick Bowie have left no traces in Madras. The

most that one can learn about them is that Miller was made assistant surgeon in March, 1777, and hospital surgeon on May 22, 1780. The others all were mates from July, 1778, and hospital surgeons or assistant surgeons on various dates in 1787 and 1788.

Robert Trotter was made mate in the Honourable Company's service, June 8, 1779. He was made assistant surgeon May 17, 1782, and died November 10, 1793. His grave is to be seen in St. Peter's Cemetery at Tanjore. His brother, a Colonel Trotter, who was Commandant at Palamcottah, and who died at Courtallam on June 11, 1819, at the age of 62, is buried in the old cemetery at Palamcottah. Both these Trotters were sons of Thomas Trotter, Baillie of Edinburgh, by Charlotte, daughter of David Knox, a nephew of the religious reformer.

The remaining names in the list seem all to have been engaged as mates on varying dates, from 1779 to 1782. They became assistant surgeons on different dates from 1782 to 1786. The most distinguished of these men seems to have been Henry Harris, who was made assistant surgeon May 4, 1783, and became first member of the Medical Board in 1813. He died August 10, 1822. There is a memorial to him in St. George's Cathedral, Madras, on which is recorded: "His superior abilities, his almost unequalled skill, and extreme kindness and humanity in his professional capacity are too well known to need any eulogium here. This humble tribute is erected by his afflicted wife, who can never cease to lament the irreparable loss herself and children have sustained, or to remember his many virtues and good qualities, and whose greatest consolation is the hope of being reunited in another and better world." Harris seems to have been married three times—first to Jane Charles in 1786, again in 1805 to Mrs. Mary Baddeley, and in 1811 to Mrs. Jane Brown, *née* Aylmer. His eldest son entered the Bengal Artillery, and died in London in 1871, leaving a son who became General Stuart Harris and one of whose sons, G. F. A. Harris, is in the Indian Medical Service of our day. The old Henry Harris of this list was a great linguist and an authority on the Hindi of the Dekhan. In Shakespeare's "Dictionary of Hindustani" one finds constant references to the Harris MSS. which are in the library at the India Office.

Andrew Berry was promoted to be assistant surgeon on September 27, 1785. He rose to be third member of the Medical Board in 1807. He was nephew of James Anderson, who heads the list now under review. Of the others, Michael Corbet seems to have died at Cuddinore on September 4, 1793. One has failed

to find his grave or any details about him. John Campbell soon left the medical establishment and took a commission as an ensign of artillery. He died February 3, 1800, as a Captain, and is buried in St. Mary's Cemetery, Madras. Of Bernard McMahon the only information is that he died at Wallajabad on May 5, 1793.

In closing these notes one can only express regret at their poverty. Poor and sketchy as they are, they have been difficult to compile. Their compilation has meant many hours' tramping through old cemeteries and the examination of church registers, but to anyone who takes an interest in these old time affairs such work is full of fascination. I confess to being fond of such pottering, and perhaps to descendants of these men the perusal of this article may be as interesting as its preparation has been to me.

Reviews.

A Clinical System of Tuberculosis. By Bandelier and Roepke. London: Bale, Sons, and Danielsson, 1913. Pp. xii and 526. Price 21s. net.

This translation from the second German edition of Bandelier and Roepke's work will be welcomed by all who have to deal with cases of tuberculosis on any scale. The book deals with all forms of tuberculosis, both medical and surgical, though, as might be expected, much greater emphasis is laid on the medical aspect of the subject; and one would search in vain for a detailed account of the treatment, say, of Pott's curvature. The earlier and larger section of the book deals with pulmonary tuberculosis. The description is a little "stodgy" at times, but one remembers how difficult it must be to deal graphically with such a protean disease as pulmonary phthisis.

One thing is brought out clearly, and that is that phthisis may exist without any very marked signs referable to the lungs, and that when the classical physical signs are present the disease has already advanced considerably. This is a point which cannot be insisted on too strongly, for to wait, as many do, for definite physical signs or for the discovery of tubercle bacilli in the sputum, is only too often to waste valuable time at the most valuable period in the course of the disease. In the part dealing with the bacteriological diagnosis of the disease many valuable hints on technique will be found. In this the authors make the statement that only 10 per cent of really first stage cases have tubercle bacilli in their sputum.

The writers attach special importance to the subcutaneous injection of old tuberculin for the diagnosis of doubtful cases, a method which is

very valuable in non-febrile cases, but they do not seem to appreciate the value of the opsonic index when dealing with febrile and other cases where the inoculation of old tuberculin is contra-indicated.

The section on treatment commences very wisely with a paragraph on the psychical treatment of cases of phthisis; there is no experienced practitioner who has not convinced himself of the extreme importance of what one might call the moral control of sick people, and in no condition is it more valuable than in cases of phthisis, where every detail of a patient's life has to be regulated. Whether such a thing can be taught or not is another matter, for it embraces many factors, a profound knowledge of disease processes, an equally deep experience of human nature, and an ordered sympathy with human suffering; these things are given to all in more or less degree, but in their highest and altogether they are very rare.

With regard to tuberculin treatment, the authors advocate the gradually increasing dose, stopping short of reactions, with short intervals between the doses. It is difficult to see how this method fits in with our knowledge of immunity processes in general, and as is well known, the followers of Wright look on the high dose method as dangerous. We, who have had experience of Wright's method, are convinced that it is capable of producing remarkable results, but it must be allowed that thoughtful physicians have obtained equally and possibly more favourable results with the high dose method, and there is an increasing number of men in this country who use the latter method. Probably with greater knowledge, we shall be able to reconcile the differences. It seems clear, however, that whereas high doses are unsuitable for markedly febrile cases, one can often do a great deal of good by the use of minimal doses in such cases.

A perusal of the chapter on drug treatment will act as a sufficient corrective to any enthusiasms which may have been aroused by the reading of the catalogues of synthetic chemists or of the accounts which appear from time to time of marvellous drug remedies for tuberculosis. One has only to remember the axiom laid down by Sabouraud years ago, that no drug will destroy germs before it has destroyed the tissues in which they lie.

The section on symptomatic treatment is full of useful suggestions, and should be very helpful when dealing with difficult cases.

The chapter on prophylaxis is well worth reading, it displays the breadth of view and the appreciation of social and political factors which are so necessary for any effective attempts at prevention.

Altogether, the part of the book dealing with phthisis is one which will well repay perusal; it gives a good account of modern German practice. The only marked omission which we have to note is the scanty reference which is made to the treatment by graduated exercise, which has so many advocates in this country. The remainder of the work, dealing with tuberculosis of other organs, is equally good. One does not get many surgical details, but from a medical point of view it is excellent. Altogether the volume is a very valuable contribution to the literature on tuberculosis, and as it deals with all forms of the disease, it is one which is peculiarly valuable for reference.

W. S. H.

MINOR MALADIES AND THEIR TREATMENT. By Leonard Williams. Third Edition. London: Baillière, Tindall and Cox, 1913. Pp. vii and 396. Price 5s. net.

This is a third edition of Dr. Williams's useful little book, and the fact that the edition has been called for so soon is sufficient evidence of its popularity. Minor maladies are the bane of medical practice, even a "slacker" can be roused to energy with a serious case of illness, but it requires great enthusiasm to keep up an interest in such things as backache and borborygmi. One great disadvantage of the flood of minor ailments is that it is apt to make one overlook serious conditions; in this matter Dr. Williams's book will tend to keep one straight, for he very rightly draws attention to such possibilities as a sore throat being diphtheritic, headache being due to anæmia, and dyspepsia having a cancerous origin.

The hypothetical explanations which the author gives for many symptoms need not be taken too seriously, we are all apt to indulge in hypotheses, and we often forget what little basis they have in established fact. The main points which one looks for in a book of this kind are, what may be a possible cause for such and such a symptom, and what can one do to relieve the patient? Suggestions of this kind are abundantly present in Dr. Williams's work. Besides dealing with minor maladies, the book has chapters on general health, change of climate, "some drugs and their uses," and on insanity, all of them written in a vigorous and chatty fashion, which carries one on even if the reader does not quite agree with all that is written.

It is a very useful little book, and those who possess it will often get much needed help by a reference to its pages.

W. S. H.

STUDIES IN SMALLPOX AND VACCINATION. By W. Hanna. Bristol: John Wright and Sons, 1913. Pp. 52.

This small monograph is the result of a study of an outbreak of smallpox at Liverpool. The statistics which the author gives of the effect of vaccination on the incidence and mortality of smallpox are of the usual convincing character. The case mortality among the vaccinated was 2·9 per cent, and among the unvaccinated 27·2 per cent; other figures show the influence of the passage of time in reducing the protection derived from vaccination. For medical men statistics as to the value of vaccination are no longer necessary, but it is as well to have them handy in order to convince misguided persons who have been carried away by the writings of anti-vaccinationist fanatics. One very interesting observation made by Dr. Hanna is: That even when vaccination is carried out after the appearance of the smallpox eruption it has a distinct effect in hastening the drying-up stage, and in preventing or modifying suppuration in the vesicles. On these grounds he recommends vaccination as a routine treatment of cases admitted for smallpox. The book contains a series of very fine photographs illustrating smallpox and the influence of vaccination on its severity. One practitioner of our acquaintance has a series of similar photographs hung up in his surgery, and he boasts that he has very few "conscientious objectors" among his patients.

W. S. H.

ANNUAL REPORT ON THE RESULTS OF TUBERCULOSIS RESEARCH, 1911. By Dr. F. Köhler. London: John Bale, Sons, and Danielsson, Ltd., 1913. Pp. iv. and 245. Price 7s. 6d. net.

The immense growth of medical literature in general, and of the literature of tuberculosis in particular, has rendered works of the type now under review imperatively necessary. Dr. Köhler has brought together a vast amount of material in one comparatively short volume, and has arranged it conveniently in sections dealing with general considerations, distribution, etiology, pathology, diagnosis, prophylaxis, and treatment. A good general index and an index of authors make the contents readily accessible. In compiling such a work of reference as this, the difficulty of selection is very great. Tuberculosis is a disease that sets all kinds of people thinking and, nowadays, to think is to write. It is, therefore, not to be wondered at that the papers to be dealt with are of very unequal merit. We incline to think that the author would have been well advised to have devoted the space at his disposal to a more detailed consideration of a smaller and more select number of references, but we realize the difficulty of his task and admit that our criticisms might be applied to almost any compilation of a similar nature. The volume certainly realizes its object of providing the reader with a concise summary of the most important recent work on tuberculosis. In the present imperfect state of our knowledge of this disease, it is natural that we should turn first to Section VI, as pathology, using the term in its widest sense, is likely to furnish the clue to prevention and treatment by enlarging our comprehension of the essential problems of tuberculosis.

A very important paper by Landmann is noticed at considerable length (Landmann: "Tuberkulinreaktion und Anaphylaxie"), in which the view is expressed that there are essential differences between the tuberculin reaction and true anaphylaxis. Landmann is unable to produce more than a condition of hypersensitiveness to tuberculin by injections of "old tuberculin" and tuberculol C in guinea-pigs, but can bring about true anaphylactic shock by means of an intravenous injection of tuberculol B in animals sensitized by a previous inoculation with this substance. He summarizes the differences between the two conditions thus:—

Anaphylaxis.	*Tuberculin reaction.*
Immediate incidence of symptoms.	Incubation stage even when intravenously injected.
Fall of temperature.	Rise of temperature.
Invariably typical convulsions, dyspnœa and pulmonary emphysema.	None of these symptoms.
Reaction predominates when intravenous injection is used.	Reaction just as frequent after subcutaneous as after intravenous injection.
Invariably passive transmission.	No passive transmission.

We gladly quote this table, as we believe it to express a true conception of a situation which has been complicated by attempts to explain two separate phenomena in identical terms. The important work of Much is noticed fully. This observer, working with a modification of Gram's stain, has been able to demonstrate the presence of a hitherto unrecognized form of the tubercle bacillus, a granular Gram-positive rod showing no trace of acid-fast substance; while he has found that the typical slim acid-fast rod characteristic of the disease is, if stained by

his method, seen to consist of an acid-fast body in which Gram-staining granules are present, or to which they are attached in varying number and size. The work of Deycke and Much on the various methods by which the tubercle bacillus can be brought into solution, and the immunizing powers of solutions of this organism, is likely to lead to interesting developments. Under the heading of "Distribution," two papers by Pollack deserve particular attention from persons interested in the tuberculosis of infants. It is curious that the high morbidity and mortality amongst primitive peoples when brought in contact with civilization should be so often noticed and so seldom associated with its true cause, the absence of previous contact with the germ of the disease, and consequent want of the relative immunity that such contact confers. A paper by J. H. Brewer on "The Distribution of Tuberculosis among the Native Troops of the United States in the Philippines" affords an excellent example of this. The volume proffers a mine of information to persons in search of references to recent work on tuberculosis, and can be thoroughly recommended for this purpose. S. L. C.

THE SOLDIER'S FOOT AND THE MILITARY SHOE. A Handbook for Officers and Non-commissioned Officers of the Line. Edward Lyman Munson, A.M., M.D. Fort Leavenworth, Kansas, 1912. Pp. 147. Price $1.35.

This excellent book will be found very useful for officers and N.C.Os., for whom it has been primarily written.

In the first chapter the author points out that although foot injuries have usually been so common among soldiers of all armies there is no reason why we should accept them as one of the inevitable concomitants of field service. It has been shown that troops with well-fitting shoes and marched under field service conditions over long distances have not suffered the slightest loss from this cause. It thus becomes evident that proper care of the feet and boots of infantry soldiers will be well recompensed by the increased efficiency of the men; and that a very large proportion of the foot injuries common to marching troops can and should be prevented by simple measures.

Chapter II is devoted to the anatomy of the foot and the action of the feet during marching. The perfect, undeformed foot is found practically only in children and among savage, non-shoe-wearing people, and as far as the soldier is concerned the undeformed foot is a figment of the imagination, practically all present some appreciable deformity or blemish.

There are many practical points in the book which will be of interest and value to company officers and others. Any boot for military purposes should be of such a form and width in its anterior part as to allow proper broadening of the foot in its metatarsal and toe regions to the extent naturally assumed by the bare foot in standing and walking. If this be not carried out, the foot is narrowed, contact with the ground is decreased, and body equilibrium is impaired. The natural effort to preserve his equilibrium when wearing too narrow shoes, causes the man to turn his toes out, thereby shifting weight from the strong outer margin of the foot so as to fall over the relatively weak inner arch.

The cause and effect of flat foot and the functions of the feet in marching are dealt with in detail and illustrated with some admirable diagrams, which serve greatly to elucidate the text.

The author directs that in marching the toes should be directed well forward so that the thrust back of the foot, and especially of the great toe, shall be in the direction of its length rather than to a certain extent across it, since muscular action of the great toe is a potent agent in the propulsion of the body forwards.

In Chapter III we find a very full discussion as to the shape and requirements of the military shoe, and it is pointed out that there is a great tendency among all to generalize for the mass from the individual particular. The fundamental requirements which must enter into every consideration for the boot of the soldier are that the shoe should be well joined, strong, solid, and flexible, that it should be comfortable and durable, as light in weight as is compatible with serviceability. It should be made in such a way as to be easily put on and taken off. The conditions as to material and make are also discussed at some length.

The fourth chapter deals with the care of the feet, and includes such subjects as flat foot, hammer-toe, tæno-synovitis, blisters, &c. There are also many useful hints as to the sock and method of wearing it to the best advantage on the march. The life of the sock is laid down as about 75 to 100 road miles, or about a week's wear in constant marching under ordinary conditions. We find no reference to foot cloths which are so largely used among Continental armies, and which have been strongly recommended by many competent authorities.

W. W. O. B.

Eye-Strain in Everyday Practice. By Sydney Stephenson, M.B., C.M.Edin., D.O.Oxon., F.R.C.S.Edin., Ophthalmic Surgeon to the Queen's Hospital for Children, London. Editor of *The Ophthalmoscope*. London: The Ophthalmoscope Press, 24 to 26 Thayer Street, W. Price 3s. 6d. net.

This little book is a reprint of articles which have appeared in various medical periodicals, and of a Richard Middlemore Post-Graduate lecture. The subjects discussed by Mr. Stephenson in the seven chapters include eye-strain, ocular headache, unusual forms of migraine in children, habit spasm, the aftermath of eye-strain; it is illustrated, as is usual in all the writings of this careful and original observer, by a wealth of references, most useful to other workers in the same field.

The chapter on "ocular headaches" is particularly valuable, giving as it does a succinct account of the different types of headache, and emphasizing inferentially the need of carefully eliminating all non-ocular causes before pronouncing an individual symptom-complex to be definitely due to eye trouble. In army ophthalmic practice, the time of the specialist and of the soldier is often wasted by cases sent "to have sight tested" when more careful preliminary examination and inquiry might have shown the symptoms not to be due to visual defect. In "The Aftermath of Eye-Strain" the author incidentally sums up the evidence for and against an intimate connection between eye-strain and epileptiform seizures; his remarks are well worth bearing in mind by medical officers puzzled as to the ætiology of obscure varieties of "fits" in young recruits.

Small as the book is, it contains a large amount of compressed information, and can be particularly commended to R.A.M.C. officers, as it is written with a breadth of view and lucidity not invariably found in the works of specialists.

M. T. Y.

Current Literature.

Salvarsan and Neosalvarsan.—In the first number of the *Zeit. für Chemotherap.* for this year there are reviews of the Continental, American, and English literature of salvarsan and neosalvarsan which appeared during the year 1912. The intravenous method of administration is adopted almost universally. It was claimed that intramuscular injections of neosalvarsan are painless, but Jordan finds that they are followed by fever and local reaction. The use of distilled water which is free from micro-organisms living or dead is imperative. Favento reported a death which was caused probably by the impurities in the water. The sequence of symptoms in those cases which end fatally after the administration of salvarsan or neosalvarsan is usually constant. Fever, vomiting, general distress, convulsions, cyanosis precede death which is caused by the dyspnœa. Schlasberg finds that salvarsan causes cylindruria when it is injected intravenously, hence it has a specific action on the renal capillaries. Wechselmann thinks that if the renal epithelium has been injured by mercurial treatment, the combined effects may end in the defective elimination of the salvarsan by the kidneys; it remains circulating in the blood, impairs the oxygen carrying powers of the red corpuscles, and death occurs from CO_2 poisoning. He insists on the necessity of a daily examination of the urine, and of the cautious use of mercury.

To cure primary syphilis in which the serum reaction is positive, six injections of 0·4 to 0·5 grm. of salvarsan are required; should secondaries have appeared, then no less than 4 to 5 grm. of salvarsan combined with mercurial courses must be given. The injections should be made at intervals of not less than five to seven days, with a month's rest in the middle of the course.

Much work has been done on the changes in the cerebrospinal fluid which are found in syphilis. Dreyfus states that this secretion is abnormal in 80 per cent of cases of early secondary infection, and in every case where nerve complications have supervened. Gennerich advises that such cerebrospinal lesions should be treated intermittently until the fluid obtained by lumbar puncture is normal. An example is given of inadequate salvarsan treatment which resulted in general paralysis two years later; another case is cited in which a salvarsan nerve sequela of early secondary syphilis, insufficiently treated, was succeeded by cerebrospinal syphilis in fifteen months' time. Gebb relates a case of double optic neuritis, opaque vitreous and central scotoma, which disappeared rapidly under salvarsan, although it had resisted mercury. Lewinstein found that three doses of 0·4 grm. of salvarsan were not sufficient to prevent severe lesions of nearly all the cranial nerves which came on three months afterwards. Moldowan observed nerve complications in 0·5 per cent of 2,000 syphilitics treated with salvarsan; Haccius in 3 per cent of 220.

A considerable amount of evidence has accumulated that intermittent courses of salvarsan, broken by rests of one or two months, relieve the signs and symptoms of locomotor ataxy.

Though a single injection does no good and may do harm in general paralysis, Donath has observed marked improvement in three out of twenty-eight early cases which had received extended courses of salvarsan.

Bierbaum has used salvarsan with success in anthrax and erysipelas, and Szametz has employed it in chorea with good effect.

The general trend of opinion on the value of neosalvarsan appears to be that it possesses no great advantages over the older preparation. Applied in a 2 per cent solution to the eye in interstitial keratitis it has done good.

In America, a patient had the signs of commencing optic atrophy which came on ten weeks after an intramuscular injection of an oily emulsion of salvarsan. The cerebrospinal fluid was normal; intensive mercurial treatment had been carried out almost continuously for four years. Excision of the necrotic area caused by the salvarsan resulted in complete recovery of the eyesight and field of colour vision.

The American experience corresponds with that elsewhere in the futility of giving a single dose only of salvarsan in secondary syphilis. Two or more courses of salvarsan combined with three courses of mercury are generally recommended.

Seven nerve relapses were noted in 681 cases treated by four dermatologists. Post recorded four nerve palsies which occurred in patients who had not received salvarsan.

Collins and Armour, of the New York Neurological Institute, treated seventy-five persons suffering from syphilitic diseases of the nervous system with from one to six doses of 0·6 grm. of salvarsan. Twenty-two of thirty-two tabetics showed remarkable improvement. Three of nine general paralytics were influenced favourably. The results were good in eight out of nine cases of meningomyelitis. Sachs and Straus voice the almost universal opinion when they say that though salvarsan has no curative effect in tabes and paresis, yet it ameliorates some of the symptoms in a fair proportion of patients.

Martin has treated fifty-two cases of pellagra, and he states that salvarsan causes the rapid disappearance of all the symptoms except the neuritis, but relapses are frequent. Cranston used the remedy in eleven cases; two were cured clinically.

In the review on salvarsan therapy in England, Gibbard and Harrison's are the only statistics given with the exception of Browning and Mackenzie's results in parasyphilis. Twelve of fifty-eight cases of early general paralysis, and three of seven cases of tabes showed improvement. C. B.

Syphilitic Disease of the Aorta.—Stadler (*Berlin. klin. Woch.*, No. 11, 1913) has investigated 248 cases of syphilis of the aorta and has published his conclusions in a small book ("Die Klinik der syphilitischen Aortenerkrankung," Fischer, Jena). Among 256 cases of acquired syphilis, in which a post-mortem examination was made, he found typical aortic sclerosis in 211, and in 117 cases this was the direct cause of death. The prognosis of syphilitic aortic incompetence is bad. C. E. P.

Arsenic in the Treatment of Kala-azar.—Roux (*Ind. Med. Gaz.*, April, 1913) reported the successful treatment of kala-azar with arsenic. A special compound of arsenic called Ramalline was employed, which is well tolerated by patients, so that a larger dose of arsenic can be given. The preparation is given in pills, each of which contains 1·25 mg. of arsenical salts; eight pills (i.e., 1 cg. of arsenic) were given daily. One case after three weeks' treatment recovered sufficiently to resume work. Roux does not advise this treatment for children aged under 9 to 10. C. E. P.

Gaseous Disinfection of Equipment in the Field.—Munson (*Mil. Surg.*, February, 1913) describes a simple apparatus which he has invented for the disinfection of equipment in the field. It consists of a metal vessel weighing 5 lb. Inside this is a smaller vessel to hold the fluid reagent; at its upper part is a compartment in which the solid reagent is placed. When ready for use the bottom of the small compartment is pushed down by means of a rod which projects through the lid of the apparatus. Two tubes open out of the container, only one of them is fitted with a stop-cock, the other is permanently open, thus obviating the risk of explosion. A gas bell is fitted to catch any fluid driven off by the energy of the chemical action. The small apparatus will take a charge of 60 c.c. of potassium permanganate and 150 c.c. of formalin.

In order to economize time and reagents, Munson strongly recommends that the equipment to be disinfected should be placed in a closed bag. Large paper bags will do, or the men's waterproof ponchos can be folded to make a bag and the edges fastened together with strapping plaster applied hot. The open tube of the container is placed inside the bag. Using 100 c.c. of formalin it was found that complete sterilization of bedding and clothing could be effected in twenty minutes. All insects are destroyed in eight minutes. C. E. P.

Fries's Apparatus for Performing Artificial Respiration.—Cramer (*Das Rote Kreuz*, February 2, 1913) has contributed an illustrated article describing the use of this apparatus, which the inventor has named the "Pulmotor."

Its structure cannot be entirely seen from photographs accompanying the article, but its essential parts may be guessed at and are shown in the sketches here given.

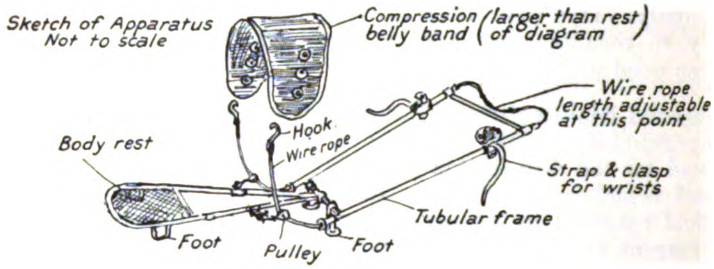
It consists of a tubular quadrilateral frame whose proximal transverse member is formed by a T-piece at the head of a platform which supports the patient's body. The platform is raised about 5 in. from the ground on two looped and two columnar feet.

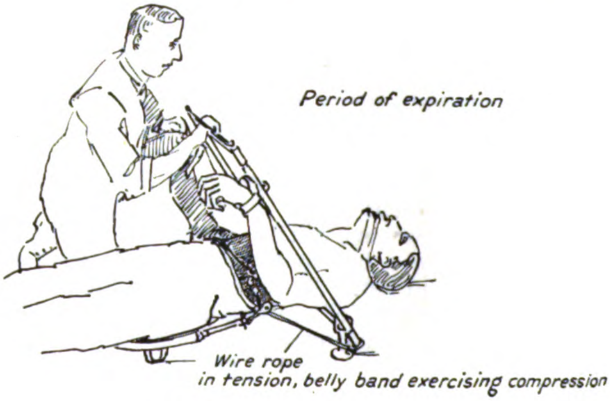
The sides of the quadrilateral frame are produced beyond the proximal cross-piece for about 4½ in. They are pivoted to the ends of the cross-piece.

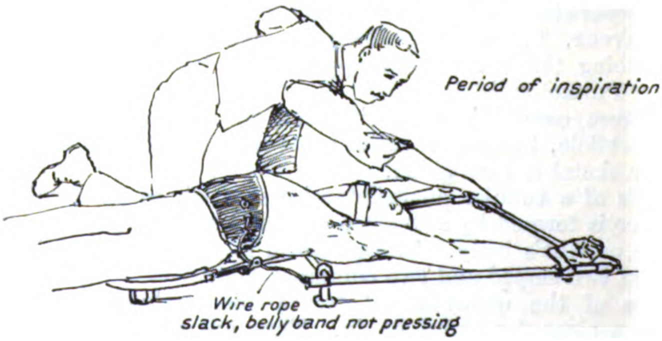
The frame is thus capable, when the body-rest is on the ground, of being moved through a semi-circle in the vertical plane.

Attached to the sides of the frame, at about 9 in. from the far end, are attachments for the patient's wrists, with straps and clasps. Attached to the sides of the body-platform are two pulleys.

A wire rope, whose length is adjustable near the distal crossbar, runs through the tubular sides, and its free ends, after passing through the pulleys, terminate in hooks to engage in lace-holes in a compression belly-band, which is made of stout material, and provided with metal eyelet-holes to receive the hooks.







The method of its working may be seen from the sketches.

The patient is laid on the platform with his head overhanging the proximal cross-piece, which is on a level with the scapular spines.

The wrists are fastened to the clasps, the belly-band is hooked to the hooks, the wire rope is adjusted and pulled tight with the movable frame in the vertical position.

When the frame is carried down over the body the patient's arms go with it, and the produced lower ends of the sides of the frame go backward, and so pull on the belly-band and compress the belly, causing expiration. When the frame is raised and carried backward the belly-band is slackened and the arms are raised, as in the Sylvester method. It can be worked by one person. H. E. R. J.

New Ambulance Cart—Russian Army.—Extract from *Journal of the Royal United Services Institution*, vol. lvii, January, 1913:—

. . . . . .

"RUSSIA.

"*New Ambulance Cart.*—Army Order 452, 1912, introduces a new pattern of two-wheeled cart, with stretchers, capable of carrying two lying-down cases. The weight of the vehicle is 5 cwt. One-horse draught is provided, and the driver is expected to lead the horse. The old ambulance carried only one lying-down case, and was driven from the box." C. E. P.

Bulgarian Army Medical Organization in the Field.—Regt. arzt. Dr. F. Tintner (*Militärärzt.*, No. 6, March 29, 1913), in the course of a lecture on his experiences during the Balkan War, stated that the Bulgarian medical echelon in the field consisted of:—

(1) Regimental aid-posts, one for each battalion, established by the regimental medical personnel.

(2) Regimental hospitals, established by the regimental medical personnel with its equipment, which comprises an ambulance wagon, a medical stores wagon, pack animals, stretchers and tents.

(3) Divisional hospitals. These establish the main dressing station.

(4) Mobile field hospitals.

(5) Semi-mobile field hospitals.

(4) and (5) correspond to the Austrian Reserve Hospitals.

A serious fault in the medical organization was the want of means of communication between the regimental aid-posts and the main dressing station. The latter was usually 2½ miles in rear of the fighting line.

He regretted that he was precluded from giving further details of the field medical organization. C. E. P.

Experiences in the Balkan War.—Pucher (*Berlin. klin. Woch.*, April 14, 1913, p. 709) read a paper on his experiences with an Austrian Red Cross unit. His party was employed in the Tashkishli barracks, which had been equipped as an emergency hospital. Altogether 650 wounded were treated with a mortality of 1 per cent; 32 per cent were invalided, and 67 per cent. recovered. The proportion of wounds by rifle bullets to those by artillery was as 58 to 42. Wounds of the extremities made up 70 per cent of the whole, wounds of lung 3 per cent, all of which recovered, abdominal wounds 4 per cent. Three-quarters of the cases were septic. Of four cases of tetanus one died; antitetanic serum was useless.

Patients took the anæsthetic well, and it was not followed by any unpleasant consequences. As far as possible conservative surgery was

carried out, although this frequently necessitated a longer stay in hospital for the performance of plastic operations. The small-bore bullet appeared to be humane, but artillery wounds were extremely serious. Tincture of iodine and mastisol proved most useful. Voluntary aid nurses were not altogether satisfactory. C. E. P.

Cholera in the Balkan Campaign.— Kraus (*Berlin. klin. Woch.*, March 17, 1913) read a paper at a meeting of the *Gesellschaft der Aerzte zu Wien*, in which he described the work he did to check the incidence of cholera among the Bulgarian troops. The infection was spread by drinking the river water in which cholera corpses had been thrown, a stringent order was therefore issued that nothing but boiled water should be used by the troops. By the middle of November the third army in the Tatchaldja lines had some 30,000 suspected cases, of which, roughly, 3,000 died. Nine bacteriological laboratories were organized to examine suspicious cases. Isolation hospitals were organized for cases of cholera. All patients admitted to hospital, as well as whole units of the army, were vaccinated against cholera. By the middle of December cholera had been stamped out in the Tatchaldja lines. Tincture of iodine given thrice daily was found efficacious both as a preventive of cholera and also in eliminating the vibrios in carriers' stools. It is proposed to vaccinate the whole of the civil population of Bulgaria against cholera. C. E. P.

Sickness among the Troops during the Campaign in Lybia.— During the course of a debate Senator Santini mentioned the following facts. On the arrival of the Italian troops in Tripoli there was a complete absence of all sanitary measures, with an insufficient and impure water supply. Cholera, smallpox, malaria, typhus, typhoid, and dysentery were prevalent, and the population was ignorant and fanatical. Under the direction of Surgeon-General Sforza sanitary matters were rapidly improved. Out of an average strength of 30,000 men there were only 1,008 cases of cholera with 333 deaths. The hospital ships evacuated 32,000 sick and 3,000 wounded to Italy.

During 1912 the establishment of the Medical Corps was 773; 764 medical officers were mobilized during the war, this necessitated recalling 11 classes of reserve medical officers for service.

C. E. P.

Medical Service in Western Morocco, April to October, 1911.— Médecins-majors Wissemans and Renaud (*Arch. Méd. Pharm. milit.*, February, 1913) published a very full account of the work of the medical services during the numerous small expeditions against native tribes. The operations were carried out by columns about 2,000 strong made up of the different arms of the service; these columns were absent from their base for roughly one to three weeks. The medical problem was to provide sufficient accommodation, on a field ambulance scale, to accompany each column, and also where necessary to establish temporary rest stations on the Lines of Communication. The medical organization of the home army was found to be quite unsuited to local requirements, and as a result of the experience gained a new unit was

evolved. This was called the "Ambulance de colonne mobile 'type Chaouia' "; it had the following composition:—

No. 1 *Section.*—Two medical officers, 1 officier d'administration, 13 N.C.Os. and men of the medical service, 25 N.C.Os. and men of the "train"; 24 pack mules for baggage, 10 mules for cacolets (6 pairs) and litters (4 pairs).

No. 2 *Section.*—One medical officer, 8 N.C.Os. and men of the medical service, 14 N.C.Os. and men of the "train"; 12 pack mules for baggage, 5 for transport of wounded.

Light Transport Section.—This was calculated on the strength of the column; for a force consisting of 2 battalions, 1 squadron and 1 battery the transport allowed for sick and wounded was 10 mules with cacolets and 3 with litters.

No. 2 Section was organized as a detachable unit to fulfil the following purposes:—

(1) When the number of sick and wounded interfered with the mobility of the column a temporary post was formed, and No. 2 Section was dropped to take care of them. Its equipment was calculated to be sufficient for eight days when used as a stationary unit.

(2) To act as a rest station on the Lines of Communication, or to form the nucleus for a stationary hospital till the latter could be established.

(3) To take charge of a convoy of sick and wounded while being evacuated to the base.

On the whole this formation was found to fulfil satisfactorily the varied requirements, but Wissemans stipulates that it should be a permanent unit, and not one hastily put together when required. He specially emphasizes the necessity of having trained ambulance mules with soldier drivers from the "train." Animals hired locally and in charge of natives were never satisfactory.

C. E. P.

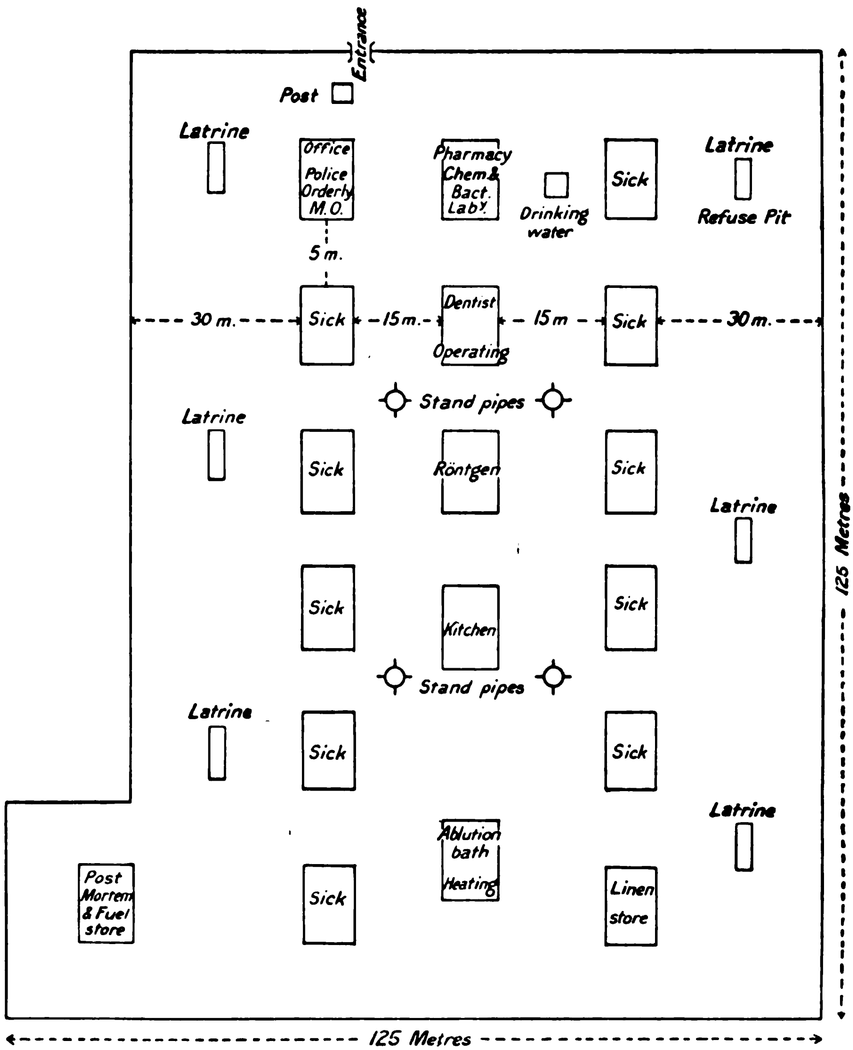
Proposed Training of Girls in Ambulance Work.—*Daily Mail*, Brisbane, January 11, 1913, states that in connexion with compulsory military training for boys there is a proposal to train girls in ambulance work, home nursing and hygiene. Training areas are to be formed and placed under female area officers, preferably school teachers. The training would be thoroughly organized under the military authorities.

C. E. P.

Clearing Hospital, German Army (*Deut. militärärzt. Zeit.*, p. 841, November 20, 1912).—At the end of January, 1912, the garrison hospital at Spandau was ordered to organize a clearing hospital of 200 beds, making use of the tents and equipment in the medical stores depot of the garrison. The object in view was to determine whether the equipment in the medical stores depot could be regarded as complete and up-to-date.

Originally two days were allotted in which to establish the hospital, but owing to the frozen state of the ground a longer time had to be allowed, as it was impossible to drive in the tent pegs till holes had been cut for them with a chisel. When conveying the equipment from

the stores to the site of the hospital observations were made as to the relative capacity and suitability of the light motor lorries and hired horse transport for transporting heavy articles. The light motor lorries are also well adapted for the carriage of sick; two lying-down patients



Topographical Map of German Clearing Hospital—*not to scale.*

can be carried on one side, one above the other, while an attendant and a small stove can be carried on the opposite side. The hospital was pitched according to a plan which had been approved by the War Office. It occupied an area 137 yards square, which was enclosed by

wire. The eighteen tents were pitched in three rows, each tent being 16 ft. from the next in the row, and the rows 50 ft. apart. To accommodate 200 patients ten hospital tents, Mark 99, were required, the remaining eight tents which occupied the middle row were used for administrative work, pharmacy and laboratory, operation tent, Röntgen ray, kitchen, ablution, stores and mortuary.

To save expense only one tent was fully equipped with floor boards, heating and lighting, and the full ward equipment. Each tent was provided with a large notice board showing what it was to be used for. Trestle tables for each tent were made by the hospital staff. The Linxweiler and Wulf-Hohmann apparatus intended for the transport of wounded was set up, and when boards had been laid across the frames they furnished very convenient shelves.

The tents were efficiently heated by iron stoves; oil lamps were tried, but did not give satisfaction. Norton tube wells were sunk, and a mobile water sterilizer (by heat exchange) was used. The kitchen floor was covered with a thick layer of dry turf.

The Voluntary Aid delegates who were attending the annual course in Berlin were shown over the hospital to give them a grasp of the requirements of a hospital.

The conclusion arrived at was that the medical equipment in the medical stores depot was sufficient for modern ideas, but that the ward and kitchen equipment needed some additions to bring it up to present standards. In war time these would be purchased locally or requisitioned.

C. E. P.

Extract from the Report of the Surgeon-General, U.S. Army, for the Year ended June 30, 1912. . . . . Laboratories. Army Medical School. . . . . Studies in Syphilis. . . . .

"*Complement Fixation with Specific Antigens.*—During the year experiments have been undertaken to determine the complement fixation power of pure cultures of spirochætes used as antigens. Through the kindness of Dr. Noguchi pure cultures of *Spirochæta pallida*, *Spirochæta pertenuis*, and *Spirochæta microdentium* were obtained, and antigens were prepared from transplants of these cultures. The antigens used were alcoholic extracts and were employed in the same manner as similar extracts in the regular Wassermann test. The results may be briefly summarized as follows: Complement fixation in syphilis can be obtained in certain sera with an alcoholic extract of pure cultures of *S. pallida*, but antigens prepared from pure cultures of *S. pertenuis* and *S. microdentium* will also give positive reactions with certain syphilitic sera. These spirochæte antigens do not give complete fixation with serum from normal individuals, and of thirty-eight specimens of serum from as many patients suffering from diseases other than syphilis only one gave a weak reaction. The results with the specific antigens were compared with those obtained with an alcoholic extract of fœtal syphilitic liver which is used in our regular Wassermann tests, and it was found that the specific antigens gave slightly weaker reactions as a rule. The results with the *pallida*

antigen approached most closely those obtained with the stock antigen, but were generally weaker, and in some undoubted syphilitic cases, where the stock antigen gave strong reactions, the *pallida* antigens gave a negative result. The results obtained with the *microdentium* antigens were almost identical with those obtained with the *pallida* antigens and the *pertenuis* closely approximated the results obtained with the others. Our experimental work suggests that the complement fixation reaction obtained in syphilis with antigens made by alcoholic extraction of pure cultures of spirochætes is a group reaction, and proves that such antigens are very much inferior, from a practical standpoint, to those obtained by alcoholic extraction of a fœtal syphilitic liver. The specific antigens we worked with could not be depended upon in the diagnosis of syphilis by the complement fixation test.

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"*Results in the Latent Stage.*—In this class of cases are included all those in which no active symptoms of the disease were present at the time of making the test. No distinction has been made between early and late latent cases. Almost all of these cases had received more or less specific treatment, and the majority were tested in order to determine whether the disease had been cured. Of this class of cases 739 were tested, with a positive result in 487, or 65·58 per cent. In most of these cases the only evidence of the disease was glandular enlargement, and in many of them even this symptom was absent. The great value of the Wassermann test in the diagnosis of syphilis is well shown in the high percentage of positive results in this class of cases.

"*Diseases other than Syphilis.*—Of the total 4,631 tests made on individuals in this laboratory, 1,269 were in patients suffering from diseases other than syphilis. Of this number nine gave a positive result, or 0·8 of 1 per cent. Of the positive cases three were in patients suffering from tertian malarial fever, the blood being tested during the febrile stage; in all, the blood became negative after the subsidence of the fever. In one case the diagnosis was undetermined fever, and the blood became negative during convalescence. In this case the exact nature of the disease could not be determined. In three cases the diagnosis was tuberculosis, but all recovered under specific treatment. In two of these cases a history of syphilitic infection was afterwards obtained, while in the other such an infection could not be excluded. In two cases, diagnosed pityriasis rosea, a plus reaction was obtained which disappeared in the subsidence of the eruption. Other cases of this disease have been tested with a negative result, but the occurrence of the reaction in this disease should be noted and further work done upon the subject.

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"*The Test as a Control of Treatment.*—In the vast majority of the 3,880 re-examinations the test was repeated for the purpose of controlling treatment either with salvarsan or with mercurials. The results have demonstrated the great value of the test as an index of the efficiency of treatment, and we have been able to trace the gradual disappearance of the reaction in treated cases and its reappearance in cases which required further treatment. The use of the test in this

manner has made possible the intelligent administration of both salvarsan and mercury, and every patient suffering from syphilis should have the treatment controlled by Wassermann tests made at intervals of at least two months. Only in this way can justice be done the patient, and the specific treatment of syphilis be controlled in an adequate and scientific manner.

"*The Specificity of the Test.*—As a result of experience, it is believed that the Wassermann test may be considered specific for syphilis if such conditions as leprosy, malarial fever, scarlet fever, and frambesia can be excluded. In all of these diseases a certain proportion of patients have given a positive result, but fortunately they can generally be excluded by the difference in the clinical history and symptoms. A few other conditions have also given positive results in isolated instances, as carcinoma, tuberculosis, pityriasis rosea, and sepsis; but such cases are so infinitesimal in number that they do not vitiate the practical value of the test. It is certain that a large percentage of positive results in non-syphilitic cases is proof of imperfect technique, and such reports must be viewed with suspicion.

"If the disease in which the complement fixation test has occasionally been found positive can be excluded, a double-plus or plus reaction is sufficient to enable one to diagnose the presence of lues. It seems certain that, under such conditions, the test is absolutely specific, whether symptoms of the disease are present or not, and whether there is, or is not, a history of infection. In those cases in which, after the appearance of a suspicious lesion, the negative reaction becomes positive, a diagnosis of lues can be made without hesitation. On the other hand, a diagnosis of syphilis should never be made upon a plus-minus reaction alone.

"The value of a negative reaction is not as great as that of a positive one. A considerable proportion of cases of lues do not give a positive reaction, even though symptoms are present, and for this reason the disease cannot be excluded on the strength of a negative result. The history of the case, the symptoms present, and the amount of previous specific treatment must all be carefully considered.

"*Practical Value of the Test.*—After nearly three years' experience with the Wassermann test in the laboratory at the Army Medical School, it has been demonstrated that it is an indispensable aid in the diagnosis and treatment of syphilis. In the military service the test has proven of the greatest value in the diagnosis of obscure and latent infections and in controlling treatment with salvarsan and mercurials. It has also been of value in preventing the enlistment of syphilitic individuals, and in clearing up the diagnosis in cases involving retirement for physical disability."

Changes in the German Army Medical Service during the Year 1912.—Stabsarzt Dr. G. Schmidt (*Berlin. klin. Woch.*, No. 4, 1913), contributed a review of the principal events affecting the Army Medical Service during the year 1912.

(1) ***Field Service Regulations and Equipment.*—A stabsarzt was attached to the Bulgarian army and another to the Greek army during the Balkan campaign to report on medical arrangements.**

New editions of the regulations have been issued dealing with the following subjects:—

(1) The Geneva Convention and Hague Conferences.
(2) Transport Drivers' Regulations.
(3) Care of medical equipment.
(4) Packing of contents of Medical Stores Depot.

On mobilization everyone who has not been vaccinated within four years is to be revaccinated.

The provision of the following has been steadily proceeded with: Wheeled kitchens for bearer companies, acetylene lighting for bearer companies and field hospitals, field X-ray wagons for medical stores depots and field hospitals, apparatus for the equipment of temporary ambulance trains, a second field dressing for every man in the Army, and the bringing up to date of surgical equipment. Water sterilizers are being provided for the advanced medical stores depots.

A Government grant was made to societies which train dogs for ambulance work in war.

The heavy ambulance wagons M. 72/74 were replaced by the M. 95 pattern; in the field hospitals the heavy 4-horsed medical stores wagons were replaced by the light 2-horsed wagons in order to make the hospitals more freely mobile.

The medical and surgical equipment has been thoroughly revised, and the new schedules will shortly be issued.

(2) *Army Medical Service in Peace.*—On April 1, 1912, there were 471 students in the Kaiser Wilhelm Akademie; sixty of these were for service in the Navy. The recent increase in the strength of the Army has necessitated the creation of a number of new appointments, the most important being the 5th medical inspectorate (Sanitätsinspektion) at Danzig.

Increased allowances have been sanctioned for medical officers of the reserve when called up for manœuvres.

(3) *Peace Hospital Service.*—New Regulations.—Regulations for motor cars in the army; this includes the motor ambulance wagon.

New hospitals and extensions have been constructed at Coblenz, Saarbrücken, Wiesbaden, and Helsa. Similar works are in course of construction at Darmstadt, Gera, Metz III, Trier, Wreschen, Wünsdorf, Ohrdruf. A new division for mental cases has been opened in the garrison hospital at Mayence.

The treatment of itch by sulphur ointment instead of balsam of Peru is to be given an extended trial.

(4) *Voluntary Aid Societies.*—The Emperor has approved of a new field uniform for Delegates of Voluntary Aid Societies. The last course of instruction was attended by 178 delegates. 3,450 members of Red Cross detachments took part in the Emperor's parade on September 1, 1912. The Emperor has approved of a uniform for Red Cross sisters; this somewhat resembles that of the Army nursing sisters.

C. E. P.

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